Robot Operation Manual

HYUNDAI Robot
Hi4
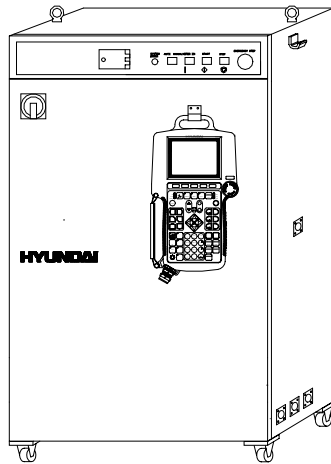
Hi4 CONTROLLER

HR100P

HR120S/150S

HR006   HR015   HR010L   HX130/165

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

△HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

▉ HEAD OFFICE

1, JEONHA-DONG, DONG-GU,
ULSAN, KOREA
TEL: 82-52-230-7901~11
FAX: 82-52-230-7900

▉ SEOUL OFFICE

140-2,GYE-DONG, JONGNO-GU,
SEOUL,KOREA
TEL: 82-2-746-4711~5
FAX: 82-2-746-4720

▉ DAEGU OFFICE

223-5, BUMEO 2-DONG,
SUSUNG-GU,DAEGU,KOREA
TEL : 82-53-746-6232
FAX : 82-53-746-6231

▉ CHEONAN OFFICE

355-15,DAGA-DONG,CHEONAN-SI,
CHUNGCHEONGNAM-DO,KOREA
TEL: 82-41-576-4294~5
FAX: 82-41-576-4296

▉ GWANGJU OFFICE

415-12,NONGSUNG-DONG,
SEO-GU,GWANGJU,KOREA
TEL: 82-62-363-5272
FAX: 82-62-363-5273

▉ 본사

울산광역시 동구 전하동 1번지

TEL: 052-230-7901~11
FAX: 052-230-7900

▉ 서울사무소

서울특별시 종로구 계동 140-2
현대빌딩 14층
TEL: 02-746-4711~5
FAX: 02-746-4720

▉ 대구사무소

대구광역시 수성구 범어 2동 235-5번지
동일산업빌딩 6층
TEL: 053-746-6232
FAX: 053-746-6231

▉ 천안사무소

충청남도 천안시 다가동 355-15번지
3층
TEL: 041-576-4294~5
FAX: 041-576-4296

▉ 광주사무소

광주광역시 서구 농성동 415-12번지
현대빌딩 별관 3층
TEL: 062-363-5272
FAX: 062-363-5273

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Chapter 1. Safety, Operation panel, Teach Pendant

1.1 Safety

1.1.1 General

The primary purpose of this Chapter is to define the safety of the user and operating personnel when using Hyundai Industrial Robots i. e. HR series and HX series robot together with Hi-4 Controller (Hereinafter referred to "the Robotics System").

This manual covers any functions and safety measures required for the operation and maintenance of the Robotics System itself. However, this manual does neither cover how to design, install and operate a complete work cell, nor all peripheral equipment and tooling which can influence the safety of the complete work cell.

This manual enumerates the safety instructions and/or recommendations for robot manipulator and controller in strictly accordance with the American National Standard Safety Requirements for industrial robots "ANSI/RIA R15.06-1999".

The technical description and installation method of the Robotics System are presented in detail at this Operation Manual and the relevant specifications for the robot manipulator and controller.

All personnel who intend to install, operate, program, repair, adjust, maintain or otherwise use the Robotics System must be trained in an approved Hyundai Robotics training course and have a good understanding and knowledge of this Operation Manual and the Maintenance Manual, and further pay their special attention and observation to the articles marked with the symbol ⚠ which are of paramount importance among the articles in this Chapter 1 "Safety".

Installation, replacement, adjustment, operation, maintenance and repair of the Robotics System must be performed by the personnel who was duly trained in an approved Hyundai robotics training course and become familiar with the proper operation of the Robotics System according to the instructions specified in Operation and

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Maintenance Manual. Hyundai maintains its various application-specific training courses for domestic and foreign customers respectively.

All owners, employers or users of the Robotics System have the responsibility to review and observe any appliable safety laws and regulations in each country and to take the necessary steps to guarantee the correct design, installation and operation of all safety devices which can secure safety of all personnel in the workplace.

In accordance with the American National Standard Safety Requirements for industrial robots "ANSI/RIA R15.06-1999", the dangerous zones of the Robotics System, i. e. the working range in which the robot together with tools, accessories and additional equipment moves, must in all cases be safeguarded to prevent persons or objects from entering the dangerous zones or to ensure that the robot system is immediately shut down by Emergency Stop system if a person or object should nevertheless enter a dangerous zone. All owners, employers or users of the Robotics System have the responsibility to take all necessary steps to make correct installation, examination and operation of the relevant safety equipments.

This manual provides specific information regarding the operation of Hyundai Hi-4 Controller together with the following robot manipulator models for the possible application usages as mentioned below;

Available manipulator Type

> HR006F(floor mounting type, 6kg)
> HR006V(wall mounting type, 6kg)
> HR015F(floor mounting type, 15kg)
> HR015V(wall mounting type, 15kg)
> HR050F(floor mounting type, 50kg)
> HR050V(wall mounting type, 50kg)
> HR100P(for palletizing application, 100kg)
> HR130IIF(floor mounting type, 130kg)
> HR130IIV(wall mounting type, 130kg)
> HR120S (shelf mounting type, 120kg)
> HR150S (shelf mounting type, 150kg)
> HX130F (floor mounting type, 130kg)

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HX130V (wall mounting type, 130kg)

HX130S (shelf mounting type, 130kg)

HX165F (floor mounting type, 165kg)

HX165V (wall mounting type, 165kg)

HX165S (shelf mounting type, 165kg)

Possible Application Usages

The Robotics System is a standard six-axis but additional axis available industrial robot for installation on the floor, on the wall or on the shelf. It is suitable for both point-to-point and continuous-path controlled tasks.

The main areas of application are

- Spot welding

- Material Handling

- Assembly

- Application of adhesives, sealants and preservatives

- MIG/MAG welding

- Palletizing and Depalletizing

- Grinding

All owners, employers or users who intend to use the Robotics System for any other purposes than the above-mentioned must request Hyundai's prior consideration and confirmation whether it can be applied without failure and/or problems or not. Please contact our Customer Satisfaction Department or your local distributor in order to check and confirm it before any users implement any special applications of the Robotics System.

Invalid environments

The Robotics System is strictly prohibited to be located, installed, maintained, used or operated in an explosive environment and any areas contaminated by oil, flammable material or chemical material.

1.1.2 Relevant Safety Standards

The Robotics System is designed as per ISO 10218, January 1992 edition that specifies the Safety Requirements for Industrial Robots and furthermore in strictly accordance with the ANSI/RIA 15.06 -1999 Safety Requirements.

1.1.3 Safety Training

All the personnel who intend to teach, operate or examine the Robotics System must be trained in an approved Hyundai Robotics operation and safety training course before starting the teaching, operation or examination of the Robotics System.

The objective of the operation and safety training course is to provide information on:

- the purpose of safety devices and their function
- safety procedures for handling the Robotics System
- performances of the robot or the Robotics System and possible hazards
- tasks associated with any specific robot applications
- safety concepts

1.1.4 Safety Marking

1.1.4.1 Safety Symbols

For the purpose of effective safety instructions, the following safety symbols are used in this manual.

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⚠	means **WARNING:**	Indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel and damage to equipment. The special attention to the careful operation and handling must be paid by owner, employer, operator or user.
❗	means **MANDATORY:**	Indicate the compulsory measures that should be performed by owner, employer, operator and user
🚫	means **PROHIBTED:**	Indicate the prohibited actions and/or operations that should not be performed by

1.1.4.2 Safety Marking

Identification plates, warning labels and safety symbols are attached to the robot manipulator and to the inside and outside of control cabinet. The designation labels and position marks are also attached to the following cables.

- Wire harness between the robot manipulator and the control cabinet
- All the electric cables in and outside both robot manipulator and control cabinet

All of these plates, labels, symbols and marks constitute safety-relevant parts of the Robotics System. They must remain attached to the robot manipulator or control cabinet at their cleary visible positions all the time.

The painted markings on the floor and the signs indicating the dangerous zones must be clearly different in form, color and style from other markings on the machine near to the Robotics System or inside the plant facilities where the Robotics System is installed.

🚫 **It is forbidden to remove, erase, cover, paint over or alter by way of editing or spoiling the cleary visible identification plates, warning labels, safety symbols, designation labels and cable marks**

1.1.5. Definition of Safety Functions

Emergency Stop Function- IEC 204-1,10,7

There is one emergency stop button on the controller and another on the teach pendant. If necessary, additional emergency buttons can be connected to the robot's safety chain circuit. The emergency stop function, which overrides all other robot controls, removes drive power from robot axis actuators, stop all moving parts and disconnect power in order not to use other dangerous functions controlled by the robot.

Safety Stop Function-ISO 10218(EN 775), 6.4.3

When a safety stop circuit is provided, each robot must be delivered with the necessary connections for the safeguards and interlocks associated with this circuit. The robot has a number of electrical inputs which can be used to connect external safety equipment, such as safety gates and light curtains. This allows the robot's safety functions to be activated both by peripheral equipment and by the robot itself.

Speed Limitation Function-ISO 10218(EN 775), 3.2.17

In manual mode, the speed of robot is strictly limited to 250 mm per second as a maximum. The speed limitation applies not only to the TCP(Tool Center Point), but to all parts of robot. The speed of equipment mounted on the robot can be monitored.

Working Envelope Restriction- ANSI/RIA R15.06-1999

The working envelop of each robot axes can be restricted using software limits. Axis 1,2,3 can also be restricted by means of mechanical stops.

Operation Mode Selection- ANSI/RIA R15.06-1999

The robot can be operated either manually or automatically. In manual mode, the robot can be operated by using the teach pendant only, i. e. not by any external equipment.

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1.1.6. Installation of Robot

1.1.6.1 Safety Fence

(1) Install Safety Fence away from the working space of robot in order to prevent from any possible collision and interface between workers and robot during the robot operation.
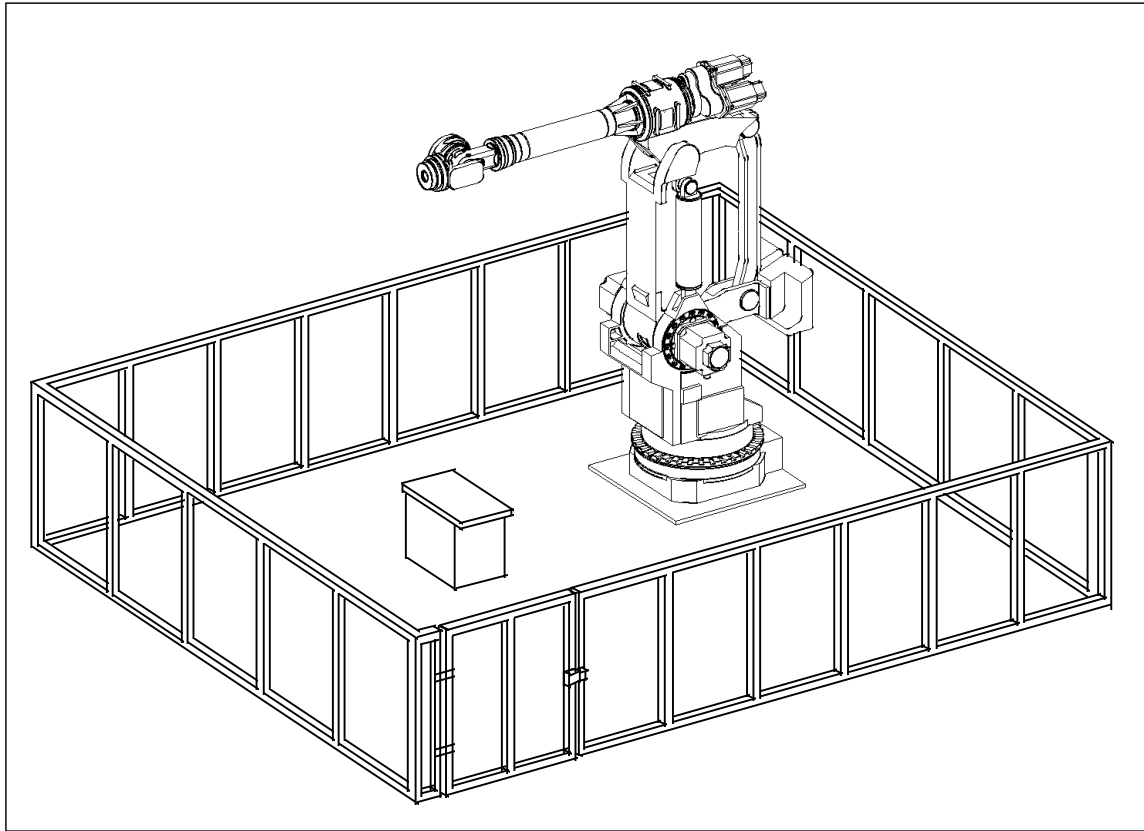
Any accidents can be take place when any workers or any other persons enter inside the safety fence without protective actions. Safety fence shall be equipped with the emergency stop mechanism that can activate emergency stop of robot if any workers would get into the safety fence for examination of robot and welding equipment and replacement of tip dresser and tip etc. during robot operation.

(2) Safety Fence shall fully cover the working space of robot and be installed to secure the enough space in order to evade any interference with robot during teaching and repair operation of workers within the safety fence. And it shall be

tightly fixed to the floor and have the relevant structure not to easily get over the safety fence.

(3) Safety fence shall be fixed installation type and have no dangerous elements such as sharp edges and rough profile etc.

(4) Gate shall be installed at Safety Fence. Safety plug shall be attached to gate. Unless unplug the safety plug from gate, gate shall not be opened. In case of unplugging the safety plug, robot shall be motor off by interlock signal. It shall be hard-wired to cause motors off the robot whenever the gate is opened. (Please refer to Chapter 12.)

(5) In case of robot operation at the state of unplugging safety plug, it shall be hard-wired to become a low speed playback mode. (Please refer to Chapter 12)

(6) Emergency stop button shall be installed at workers' easily accessible distance.

(7) If there is no safety fence, a photoelectric switch or mat switch instead of safety plug shall be installed at all the spaces within the working range of robot. Whenever workers enter the working range of robot, robot will be automatically stopped.

(8) Working space of robot as the dangerous area shall be clearly marked by painting on the floor.

❗ 1.1.6.2. Installation of robot and peripheral equipment

(1) Execute the connection work after ensuring the power-off status. There are many risks of receiving electric shock due to the usage of high voltage power source such as 220V, 440V, 80V etc. in case of primary power source connection to robot controller or peripheral equipment.

(2) Attach the warning tag "No-Access during Operation" at the gate of safety fence and further educate it as a precaution

(3) Locate controller, interlock panel and any other operation panels outside safety fence.

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(4) In case of installation of operation stand, attach emergency stop button on it. Emergency stop shall be available at any time from any locations that can operate the robot.

(5) Execute cabling and piping work in proper way for robot manipulator, controller, interlock panel, timer etc. Any loose or protruded cables and/or wires can cause workers' slippery or disconnection of cable by fork lift.

(6) Locate robot manipulator, controller and operation stand where workers can clearly see the movement of robot manipulator. When operator do not acknowledge abnormal situation of robot or other workers' working at the robot due to the invisible situation, operator's robot operation can cause a large accident.

(7) Limit the workable space of robot by utilizing soft limit or mechanical stopper etc. when the required work space of robot is smaller than the workable space of robot. In case of abnormal operation, any excessive working out of the workable space can be stopped previously. (Please refer to Operation and Manipulator Maintenance Manual)

(8) Install safety curtain or cover for spatters made during welding work which can cause personal injury or fire accident. In any case, safety curtain or cover shall be installed to allow operator to clearly see the movement of robot manipulator.

(9) Automatic operation and manual operation which mean the actual operation state of robot shall be notified to workers even in the distance by easily visible light or device. Install buzzer or alarming light for sign of starting automatic operation of robot.

(10) Remove any protrusions, sharp edges at equipments, devices around the robot which can cause personal injury or any other accidents.

(11) Input and output of workpiece by inserting worker's hands inside safety fence shall be strictly prohibited due to the risks of pressure or cutting injury accident.

! 1.1.6.3. Robot installation

Install robot as per the planning and layout which has been previously reviewed and studied for the optimized performance and functionality of the robot. In case of bad installation situation of robot, the serious problems can take place as follows;

- Error of relative position between robot and workpiece during operation.
- Bad performance quality of robot caused by vibration.
- Shortening lifetime of robot
- Cause of serious accidents

The following lists the safety precautions to which careful consideration must be made by operator, worker or installation persons.

General Safety Precautions

(1) Design and install the robot system in completely compliance with laws, regulations and safety requirements being valid in the country where the robot system is installed.

(2) All the workers for the robot system must have the good knowledge on the information specified in the operation and maintenance manual and also have a good command of operation and maintenance of the robot.

(3) Installation workers of robot must follow the safety requirements when they face any safety problems in installation.

(4) System Supplier must ensure that all the circuits utilizing safety function perfectly perform their functionalities in a safe way.

(5) Install primary power supply which can be disconnected from the place outside the operation area of the robot.

(6) System supplier must ensure that all the circuits utilizing emergency stop function perform their functionalities in a safe way.

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(7) For immediate emergency stop, install emergency stop button within operator's easily accessible distance.

Technical Safety Precautions

(1) Remove any interference problems with peripheral equipments considering dimension and operating space of the robot.

(2) Evade the installation of robot at the places where have direct ray of sun, many oil, chemical material, explosives, metal powder or humid and wet atmosphere.

(3) Install at the place where ambient temperature is 0~ 45℃.

(4) Secure sufficient space for facilitation of disassembly and examination of the robot.

(5) Install safety fence with a gate so that no worker can enter into the operating range of robot without permission.

(6) Remove any obstacles out of operating space of robot.

(7) Take the special measure considering heat dynamics in case of installation of robot at the places where have direct ray of sun or near heating equipment.

(8) Take the special measure in case of installation of robot at the place where there are a lot of dusty metal powder, chemical dusts in the air.

(9) Install robot not to receive any short circuit from welding gun and equipment. (Insulate robot arm between spot sun completely)

(10) Grounding is very important for preventing from abnormal operation or electric shock caused by noise. Observe the following installation method.

　- Install exclusive grounding terminal using class 3 or higher grounding method.(In case of input voltage of 400V or higher, observe special class 3 or higher grounding method.)

- Connect Grounding line into the grounding bus-bar inside the controller.

- In case of direct grounding of the robot by anchoring at floor, two point grounding both by robot manipulator and by controller can produce closed circuit and further cause abnormal operation of the robot on the contrary. In this case, connect the grounding line to the base of robot manipulator and disconnect to the controller. When robot trembles during stopping operation, check and examine the grounding status immediately since the possible main causes are incomplete grounding or closed circuit.

- In using built-in transformer gun, primary power cable can be easily worn out by directly contacting with the gun. In this case, connect the grounding line to the base of robot directly and disconnect to controller in order to protect controller and preventing from any electric shock.

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1.1.6.4 Space for robot installation

Install robot manipulator, controller, other peripheral equipment. Be sure that there are sufficient rooms for maintenance on the manipulator, controller and other peripheral equipment. Install robot manipulator and controller as per the guideline as described in the figure below.
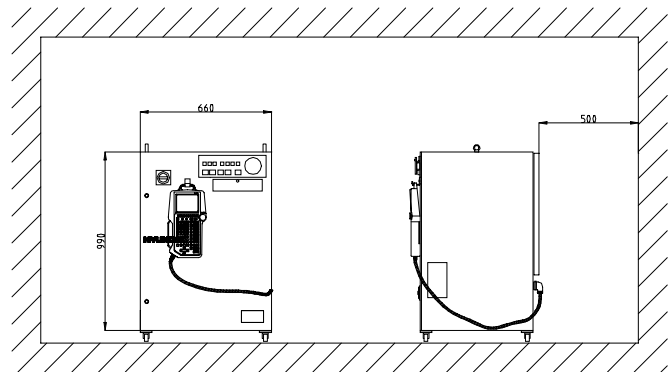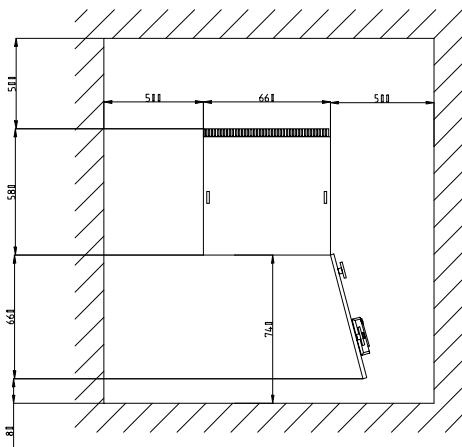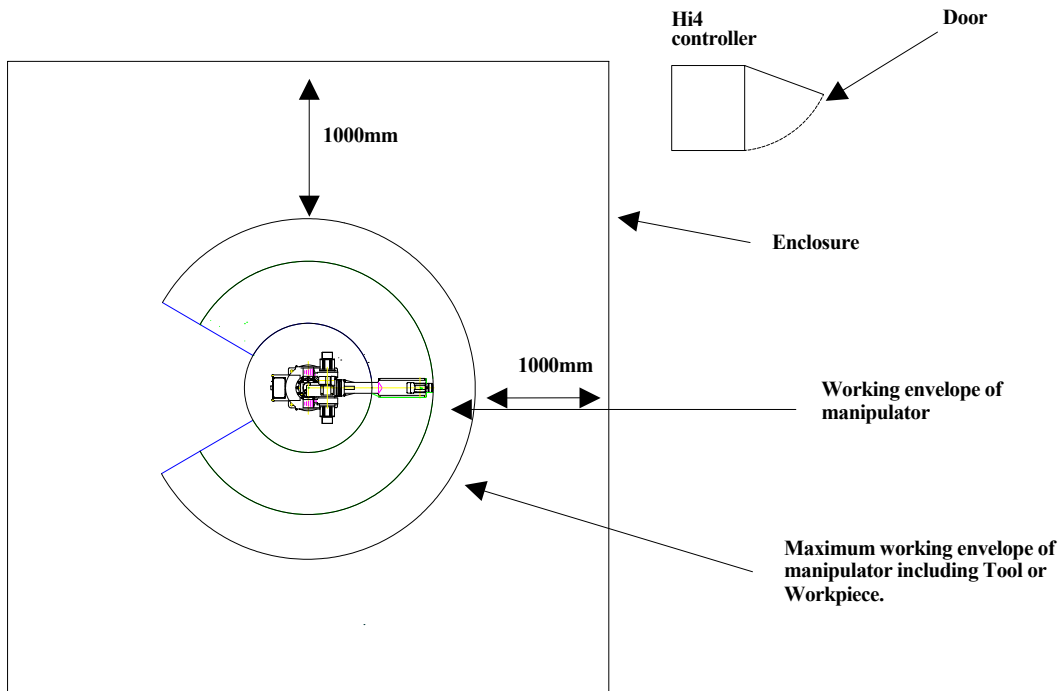
Install controller in order that maintenance work can be easily performed when door open. Secure the maintenance free area whenever robot need to be maintained. Dimension of controller as specified in the above figure can be changed according to the kind of controller.

1.1.7. Safety Working Procedures

Safety working procedures must be observed to prevent from any accidents. Safety device or circuit shall not be modified and disregarded by workers or operators at any time.

Be careful of any possible accidents caused by electric shock. All normal operations in automatic mode must be executed outside safety fence. Prior to operation, be sure there are no personnel within the manipulator's working envelope.

! 1.1.7.1. Safety measure for robot operation

(1) Have the robot system operators, any workers who is possible to operate or any superintendents attend the training courses held by Hyundai in order that they can have a good command of safety and robot functions. Do not allow workers who do not attend the training courses to operate the robot.

(2) Wear safety helmet, safety glass, safety boots during operation.

(3) 2 workers as a team must work together. One worker must supervise through operation panel while another worker make teaching operation. One worker always must be in a position to push emergency stop button while another worker execute operation work inside or outside the operation space of the robot with sufficient cautions. Furthermore, all the workers must have a good knowledge on escaping route before their operation work.

(4) Supply power-on after certainly ensuring that there is no persons within operating space of the robot.

(5) Do teaching work outside the working envelope of the robot, in principle. However, after motor-off, you may execute work within the working envelope of the robot by hand-carrying key switch or safety plug, which will prevent from automatic operation which can be made by any third parties. Furthermore, pay your special attention to direction of movements which can be made by abnormal or error situation, if any.

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(6) Superintendent must observe the followings;

  - Stay at the place where he can see robot entirely and concentrate on his job of
    superintendence.
  - Press emergency stop button if there is any abnormal situation.
  - keep any people other than the workers who are working for the robot, away from
    the working envelope of the robot.

(7) In manual mode, teaching must be made not more than the speed of 250mm/sec.

(8) Do the teaching work by laying of "Under Teaching Operation" signboard all the
   time.

(9) Any workers who enter inside safety fence must unplug and bring the safety plug
   into the safety fence.

(10) Do not use any equipment which can produce any noise around the place for teaching
    work.

(11) Do not operate teach pendant by feeling of hand only but operate it by watching
    the keypads clearly.

⚠(12) Pay your careful attention to the movement of the robot. Do not work for the
    robot under the situation the robot is behind yourself.

(13) Watch your step during your teaching work. In case of high ground teaching work
    more than 2 meters, start your work after securing the sufficient safety space for
    workers' step-on.

⚠(14) Followings are the counter measures which must be taken in case of any abnormal
    situations

  - Press emergency stop button immediately after finding any abnormal operation.
  - When you want to check the abnormal situation after emergency stop, confirm the
    stop status of the robot without any fail.
  - Robot can stop automatically due to the abnormal power supply. In this case, check

first the stop status of the robot and further investigate the cause to execute
relevant measure.

- When the emergency stop function does not work, disconnect the power supply
  immediately and further investigate the cause to execute relevant measure.
- No one who have no operation and maintenance training provided by Hyundai can be
  authorized to do the investigation of the cause for abnormal situations. In the
  event of emergency stop, re-start of motor must be made by the defined procedure
  only after implementing the measure as a result of the detailed investigation
  to the cause for abnormal operation.

(15) Prepare relevant working manual on robot operation, working method and the
  required action for abnormal situations according to the installation places and
  working contents. Proceed with any works as per the relevant working manual.

(16) Precautions during the stop of robot
  Do not access to the robot even though the robot is just stopping. There can be
  a serious accident caused by sudden movement of robot when you access to the stopped
  robot without any precaution. Followings are the cases that the robot is under the
  stop status.

No.	Robot Situation	Motor	Accessible or not
1	Temporary stopping (small problem,Temporary stop switch)	ON	Not accessible
2	Emergency stopping (Serious problem, Emergency stop switch, safety gate)	OFF	Accessible
3	Input Signal Stand-by from peripheral equipment (START INTERLOCK)	ON	Not accessible
4	During Playback completion	ON	Not accessible
5	During Stand-by	ON	Not accessible

  Always, pay your careful attention to the unexpected movement of the robot even
  though it is the above situation which you can enter to working envelope. Entering
  to the working envelope of the robot without any preparation for unexpected
  emergency situation must be prohibited at any time.

> Note) As specified in the above table, in case of temporary stopping,
> access to the working envelope of the robot is not allowed. However,
> when you try to get inside the working envelope of the robot in order
> to make corrections for minor problems such as nozzle contact and arc
> trouble, enter the working envelope of robot only after following the
> same method as you enter the working envelope for teaching work.

(17) When you finish the operation work of robot, do cleaning work for the area inside
the safety fence to remove any tools, oil or foreign material which left on the
floor. Contamination of working area by oil and any left tools can cause slippery
and personal injury. Please do your cleaning and proper arrangement regularly,

! 1.1.7.2 Safety Measure for Robot Try-out

Engineering error, Teaching error and manufacturing defects on the total system
including teaching program, jig and sequence etc. can be found during try-out of the
robot. Therefore, do your try-out operation taking your due consideration into the
safety matter. Safety related accident can took place due to the combined reasons.

(1) Check first the functions of signals and buttons such as emergency stop button
and stop button etc. before robot operation and further check error detection
function. Checking of all the signals for stopping the robot is the most important
thing. When you can foresee the possible accident previously, the most important
thing is to stop the robot.

(2) For the try-out of robot, operate in the lower speed of 20%~30% and further check
movement more than 1 cycle repeatedly. When you find any problems, modify them
immediately. Afterwards, make speed-up by the order of first 50%, second 75% and
final 100% and further check movement more than 1 cycle for each speed set-up
respectively. When you make speed set-up of high speed at the beginning, the
unexpected accident can take place.

(3) You can not foresee any problems to be made during try-out. Do not enter inside

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the safety fence during try-out. Unexpected accidents can take place easily due to the unreliable situations.

1.1.7.3 Safety measure for automatic operation

(1) Educate all the workers not to get inside the safety fence during the operation while the sign-board "No Access During Operation" must be placed at the gate of safety fence. When robot is stopping, you can get inside the safety fence after careful judgment of the situation.

(2) First check and confirm whether there are any persons inside the safety fence when you start your automatic operation. There can be any serious personal injury when you operate without checking whether there are any persons inside the safety fence.

(3) Start any automatic operation after confirming that the conditions such as program No., step No., mode, start selection etc. is relevant for automatic operation. When you make start operation under the selection of the program or step which is not valid for automatic operation, there can be serious accidents which is caused by the unexpected movements of robot.

(4) First confirm whether robot is located at the place where it can be operated in automatic mode. Further confirm whether program No., step No. and robot location are correct. Even though program No. and step No. are correct, the wrong location of robot can cause any serious accident by way of abnormal movement.

(5) You are ready to press emergency stop button during automatic operation. Press emergency stop button immediately when you face any unexpected abnormal robot movement or situations.

(6) Check any errors or abnormal status of moving path, moving situation and moving sound etc. While robot can be failed suddenly, it also can be failed by way of showing certain sympton of failure. Have your good understanding and recognition on the normal operation situations of robot.

(7) When you find any abnormal situations, press emergency stop button immediately

and make the necessary action to the abnormal situations. Unless you make any necessary action, there can be a failure which possibly result in serious personal accident as well as stop of production.

⚠ (8) When you make necessary action for any abnormal situation and check the normal operation, you can check in low speed operation whether abnormal situation is fixed. However, it must not be checked even in low speed operation under the situation that any workers stay inside the safety fence. Since it is not reliable situation, another abnormal situation or any unexpected accident can take place.

⚠ 1.1.8. Safety Measures for Entering Inside the Safety Fence

The robot is extremely heavy and powerful, even at low speed. When entering inside working envelope of the robot, the applicable safety regulations of the country concerned must be observed.

Operators must be aware of the fact that the robot can make unexpected movements. A pause(stop) of robot in pattern of movements may be followed by a movement at high speed. Operators must be aware of the fact that external signals can affect robot programs in such a way that a certain pattern of movement change without warning. During programming and testing, the enabling device must be released as soon as there is no need for the robot to move.

The programmer must always take the teach pendant with him/her when entering through the safety gate to the robot's working envelope so that no-one else can take over control of the robot without his/her knowledge. Hang up the sign-board "Under robot operation work" in front of the controller.

When you enter inside the working envelope of the robot, keep in mind the following considerations.

(1) Any workers other than programmer must not be allowed within the working envelope of the robot.

(2) The operation selector on the teaching pendant must be in the teach lock mode

position.

(3) The operating mode selector on the controller must be in the manual mode position to block operation from remote control panel.

(4) Always wear approved work clothes(no loose fitting clothes).

(5) Do not wear gloves when operating the Controller.

(6) Do not allow underwear, shirts, or neckties to hang out from the work clothes.

(7) Do not wear large jewelry, such as earring , rings, or pendants.

(8) Always wear protective safety equipment such as helmets, safety shoes(with slip-proof shoes), face shields, safety glasses, and safety gloves as necessary.

(9) Before operating the manipulator, confirm that the emergency stop circuit is functioning by pressing the emergency stop button on the operation panel and teach pendant, and confirm that MOTOR lamp is turned off.

(10) Always view the manipulator from the front when you execute any work.

(11) Follow the predetermined operating procedure.

(12) Always have an escape method and place in mind in case the manipulator comes toward you unexpectedly.

1.1.9. Safety Measures for Maintenance and Repair

!1.1.9.1. Safety measures for Maintenance and Repair of Controller

(1) Have all the workers who wish to maintenance and repair work of the robot attend the special maintenance training course held by Hyundai.

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(2) Proceed with all the work according to the maintenance and repair procedures.

(3) Check safety conditions around the workers and secure the escaping route and place in case of any dangerous situation before starting maintenance and repair work.

(4) Turn OFF the power supply when you start regular maintenance or repair, part replacement work. To prevent anyone inadvertently turning ON the power supply during maintenance, put up a warning sign such as "DO NOT TURN ON THE POWER" at the primary power supply.

(5) Always use the designated part for the replacement of failed part.

(6) Turn OFF when you open the door of Controller.

(7) After turning OFF, wait at least 3 minutes to start any work.

(8) Do not touch the SERVOPACK heat sink and the regeneration resistor since they become very hot.

(9) After maintenance is completed, carefully check that no tools are left inside the controller and that the doors are firmly closed.

1.1.9.2 Safety Measures for Maintenance and Repair of robot systems and manipulators

(1) Refer to the safety measures for maintenance and repair of controller.

(2) Proceed with any maintenance or repair work of robot system and manipulator strictly in accordance with the established procedures.

(3) The main power switch on the robot controller must be "OFF". To prevent from power ON caused by any unauthorized persons, put up the warning sign such as "DO NOT TURN ON THE POWER" at the primary power supply.

(4) Do your maintenance or repair work after fixing the robot arm in order that you

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can be safe from any possible accidents caused by falling down or unexpected moving of robot arm.

(!) 1.1.9.3 Necessary Actions after Completion of Maintenance and Repair

(1) Check there are no abnormally connected cables or assembled parts of Controller.

(2) After maintenance is completed, carefully check that no tools are left inside the Controller and that the door is firmly closed.

(3) Do not turn on the robot if you discover any problems or potential hazards.

(4) Prior to turning ON the power, be sure that there is no one within the working envelope of manipulator, and be sure that you are in a safe place yourself.

(5) Turn ON the main circuit breaker on the control panel.

(6) Check current position and status of the robot

(7) Operate the manipulator at low speed.

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1.1.10. Safety Functions

1.1.10.1 Safety Control Chain of Operation

The robot's safety system is based on a two-channel safety circuit that is continuously monitored. If an error is detected, the power supply to the motors is switched off and the brakes engage. To return the robot to MOTORS ON mode, the two identical chains of switches must be closed. As long as these two chains differ, the robot will remain in the MOTORS OFF mode. Furthermore, when safety cuicuit is disconnected, interrupting call will be sent automatically to the Controller to find out the reason for the interruption.
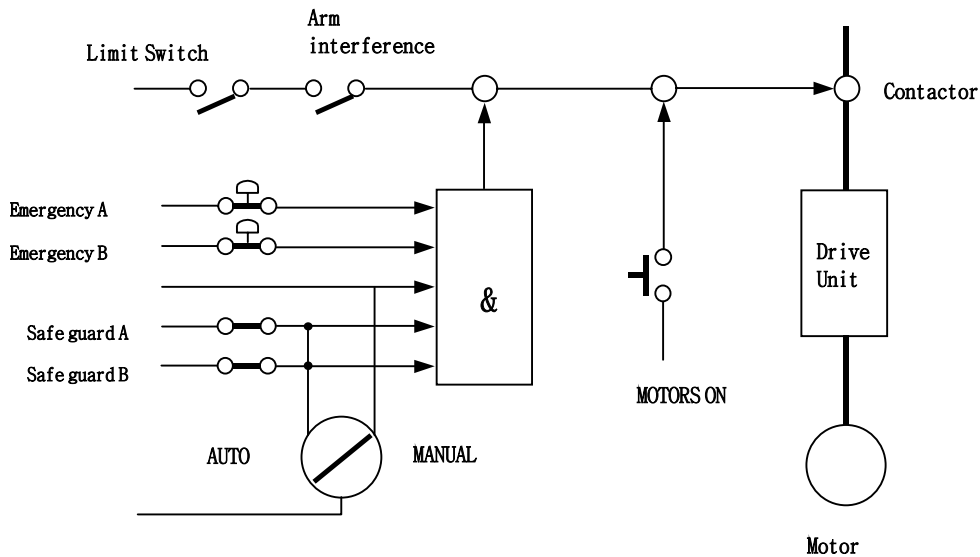
 The safety control chain of operation is based on dual electrical safety chains which interact with the robot controller and the MOTORS ON mode.
Electrical safety chain consist of several switches connected in such a way that all of them must be closed before the robot can be set to MOTORS ON mode. MOTORS ON mode means that drive power is supplied to the motors.
If any contact in the safety chain of operation is open, the robot always reverts to MOTORS OFF mode. MOTORS OFF mode means that drive power is removed from the robot's motors and the brakes are applied. MOTORS OFF mode means the status that there is no power supply to motor of robot while brake of motor is woking. The status of the switches is displayed on the teach pendant (Refer to the I/O monitoring screen of Service Menu in Chapter 6).

The Safety Chain of Operation

 The emergency stop buttons on the operator's panel and on the teach pendant and external emergency stop buttons are included in the safety chain of operation. You are recommended to install safety devices such as safety plug and safety stop device while entering inside the working envelope etc. which can be operated in the AUTO operating mode. You can connect the general safety stop devices that is active in all operating modes.

 No workers/persons can enter inside the working envelope of robot in automatic operation mode due to the unconditional operation of the safety devices(door, safety mat, safety plug etc.). In manual mode, maximum speed of robot is completely restricted to 250mm/s. The aim of this safeguarded stop function is to make the area around the manipulator safe while still being able to access it for maintenance and programming.

 When the robot is stopped by a limit switch, it can be moved from this position by jogging it with the move key in CONSTANT mode(refer to the Parameter Setting 1 of Chapter 9). Status indication is available on the teach pendant display.

⚠ The safety chains must never be bypassed, modified or changed in any other way.

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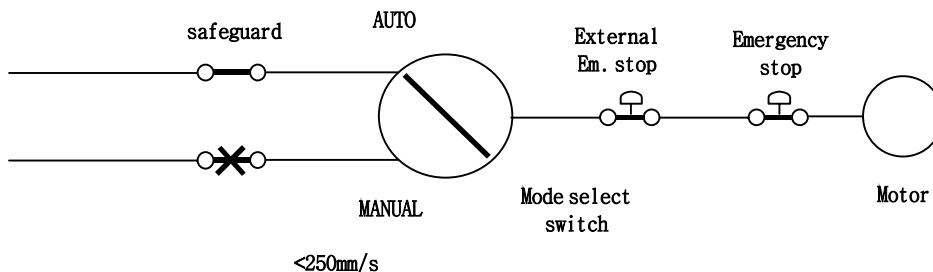
1.1.10.2. Emergency Stop

 An emergency stop should be activated when people or equipment is located at dagerous area. Built-in emergency stop buttons are located both on the operator's panel of the robot controller and on the teach pendant.
 External emergency stop devices(buttons, etc.) can be connected to the safety chain with the applicable standards for emergency stop circuits.
All controls, such as emergency stops, the control panel and control cabinet, must be located outside working envelope and easily accessible at any time.

Emergency Stop Button
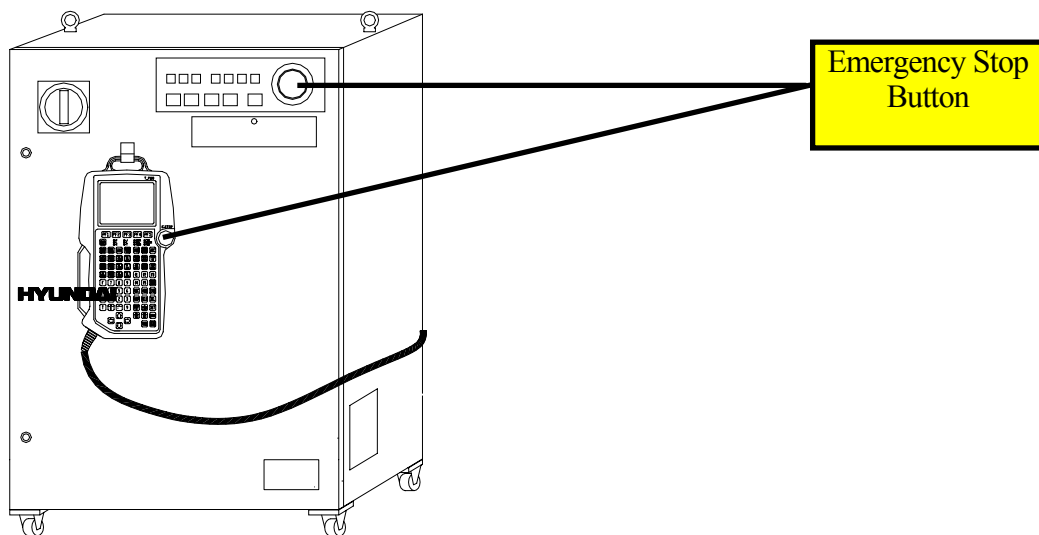
Status of Emergency stop

When you press the emergency stop button,
    - Robot stops immediately in any cases
    - Power of the robot servo system turn off
    - Motor brake of the robot is activated.
    - Message of emergency stop is displayed on screen

_____

1.1.10.3. Operating Speed

 To program the robot, the operating mode switch must be turned to MANUAL position. Then the maximum velocity of robot is limited to 250mm/s.

1.1.10.4. Connection of Safety Device

 External safety devices such as light, curtains, light beams or sensitive mats which can be adapted by the system builder execute interlocking the Controller by way of connecting with safety chain of operation within the Controller. The above devices are used for safety device during execution of normal program in automatic mode.

1.1.10.5 Limitation of Working Envelope

 When robot is not necessary to reach certain area for specific applications, working envelope of the robot can be limited to secure the sufficient safety working area. This will reduce the damage or loss in case of robot's collision with external safety arrangement such as safety fence, etc.

 Movement about axes 1, 2 and 3 can be limited with adjustable mechanical stops or by means of electrical limit switches. If working space is limited by means of stops or switches, the corresponding software limitation parameters must also be changed.

 If necessary, movement of the three wrist axis can also be limited by the central processing unit. Limitation of working envelope for all the axes must be carried out by the user. Hyundai Robot is delivered to customer as the status of full working envelope setting.

    Manual mode : Maximum speed is 250mm/s
                The manual mode must be selected whenever anyone
                enters the robot's safeguarded space.
    Auto mode   : The robot can be operated via a remove control device.
                All safety equipments such as safety gates, safety mats,
                etc., are active. No one can enter the robot's safeguarded
                space.

_____

1.1.10.6. Monitoring Function

1) Motor Monitoring Function

 The motors are protected against overload by means of temperature sensors in the
 motor windings.

2) Voltage Monitoring Function

 For the protection of power devices such as transistor etc. the servo amp module
 automatically triggers off the power switch when the voltage is too low or high.

1.1.11 Safety Related to End Effectors

1.1.11.1 Gripper

(1) When a gripper is used to grip a workpiece, the relevant measure for preventing
 from the unexpected dropping of the loaded workpiece due to loose gripper design
 must be taken by users.

(2) When any end effectors or devices are installed on robot arm, the followings must
 be observed by users.
  - Use the required size and quantity of bolt.
  - Securely fasten as per the required torque by using torque wrench.
  - Do not use the bolt which have rust or dirt.

(3) End effector must be designed and manufactured not to exceed the maximum allowable
 load at the wrist of robot. Even though power or air supply stop, the gripped
 workpiece must not be dropped from the gripper. In order to remove any risks and
 problems which cause personal injury and/or physical damage, the sharp edge and
 projection part of end effector must be made dull and smoothly.

1.1.11.2. Tools and Workpiece

(1) It must be possible to replace tools, such as milling cutters, etc., in a safe
manner. Make sure that safety devices are working correctly until the cutters stop
rotating.

(2) Grippers must be designed to keep on gripping workpiece securely even though a
power failure or a control failure take place. It must be possible to release
workpiece from the gripper in manual mode.

1.1.11.3 Pneumatic and Hydraulic Systems

(1) Design and install pneumatic and hydraulic system according to the safety
regulations.

(2) Since, after stop of robot, residual energy of pneumatic and hydraulic systems
can be still remaining, particular care and attention must be paid by user. Pressure
must be removed whenever you start repair work of pneumatic and hydraulic systems.

1.1.12. Liabilities

The robot system has been built in accordance with the latest technical standards
and safety rules. Nevertheless, the serious accidents such as death or personal injury
of operators/workers can take place due to the collision between the robot system
and peripheral equipment.

The robot system must be used by operator who has perfect technical knowledge and
good understanding on its designated use and also pay his careful attention to the
possible dangers and risks involved in its operation. Use of the robot system is
subject to compliance with these operating instructions and the Operation and
Maintenance Manual supplied together with the robot system. The safety related
functions of the robot system must not be used for any purposes other than safety.

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When you use the robot system for any other or additional purpose than its designated usage, at first, you must review whether it is valid in accordance with design criteria. The manufacturer can not be held liable for any damage or loss which resulted from such misuse or improper use.

The user, operator, workers shall have the full responsibility for the risks caused by such misuse or improper use. When you use and operate the robot system for its designated use, you must have a good command of all the information contained at these operating instructions as well as the maintenance manual.

The robot system may not be put into operation until it is ensured that the functional machine or plant into which the robot system has been integrated conforms to the specifications of the EC directives 89/392 EWG dated 14 June 1989 and 91/368 EWG dated 20 June 1991.

The following harmonized standards in particular were taken into account with regard to the safety of the robot system:
   IEC 204-1,10.7
   ISO 11161,3.4
   ISO 10218(EN 775), 6.4.3
   ISO 10218(EN 775), 3.2.17
   ISO 10218(EN 775), 3.2.8
   ISO 10218(EN 775), 3.2.7

User must take the full responsibility for any accident caused by his negligence or non-observance of these instructions. When the user provides any peripheral equipment or other equipment which are not included in the scope of supply of Hyundai robot system, HHI will not take any liabilities and responsibilities for any damages or losses caused by the mis-use or malfunction of the such equipments provided by user. User must take the full liabilities and responsibilities for any risks and damages which can take place due to the above peripheral equipments or other equipments provided by user.

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1.2 Operation Panel

1.2.1 External Shape of Operation Panel
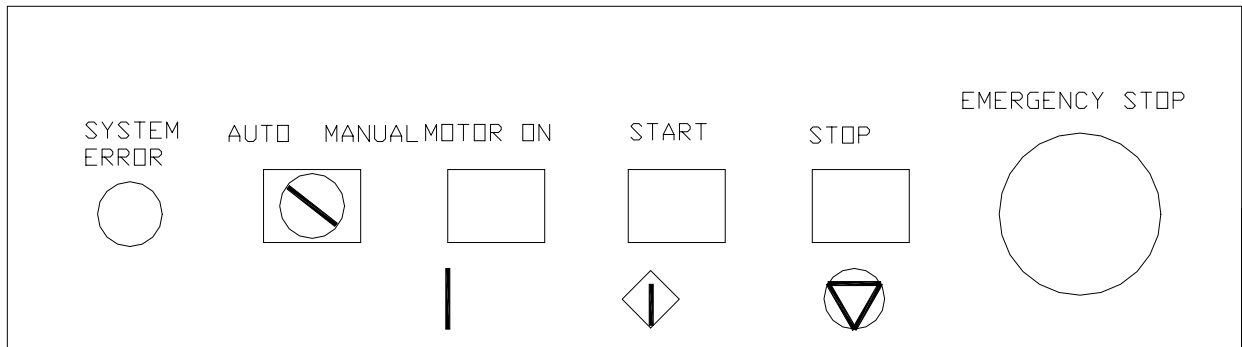
1.2.2 Buttons of Operation Panel

[ERROR]
 LED(Light-emitting Diode) indicating Synthetic Error. It flickers when system errors such as servo alarm, limit switch interference and arm interference etc.

[MOTOR ON]
 Button for Operation Standby "ON". This button is used for connecting servo power to the motors of robot. When operation standby is the state of "ON", [MOTOR ON] lamp is turned on.

[EMERGENCY STOP]
 Button for Operation Standby "OFF" in case of emergency stop and etc. This button is used for disconnecting servo power to the motors of robot. When operation standby is the state of "OFF", [MOTOR ON] lamp is turned off.

[START]
 Button for starting operation. This button is used for making playback of program. When operation start, [START] lamp is turned on and [STOP] lamp is turn off.

[STOP]

 Button for stopping operation. This button is used for stopping playback of program. When operation stop, [STOP] lamp is turned on and [START] lamp is turned off.

[AUTO/MANUAL]

 Key for selecting between automatic and manual operations. Selection state of this key, the state of safety plug and JogEnable of Teach Pendant are the indispensable factors for determining whether starting operation is ready or not.
 Please refer to the following table.

AUTO/ MAN. Safety plug	MANUAL		AUTO	
	JogEnable-ON	JogEnable-OFF	JogEnable-ON	JogEnable-OFF
Release	Impossible to Motor-ON Possible to operate JOG Possible to Step Forward and Feedback	Impossible to Motor-ON Impossible to Operate Jog Impossible to Step forward and Feedback		
Locking	Impossible to Motor-ON Possible to operate JOG Possible to Step Forward and Feedback	Impossible to Motor-ON Impossible to Operate Jog Impossible to Step forward and Feedback	Impossible to Motor ON	Possible to Motor ON, Impossible to normal speed operation

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1.3 Teach Pendant

1.3.1 External Shape of Teach Pendant
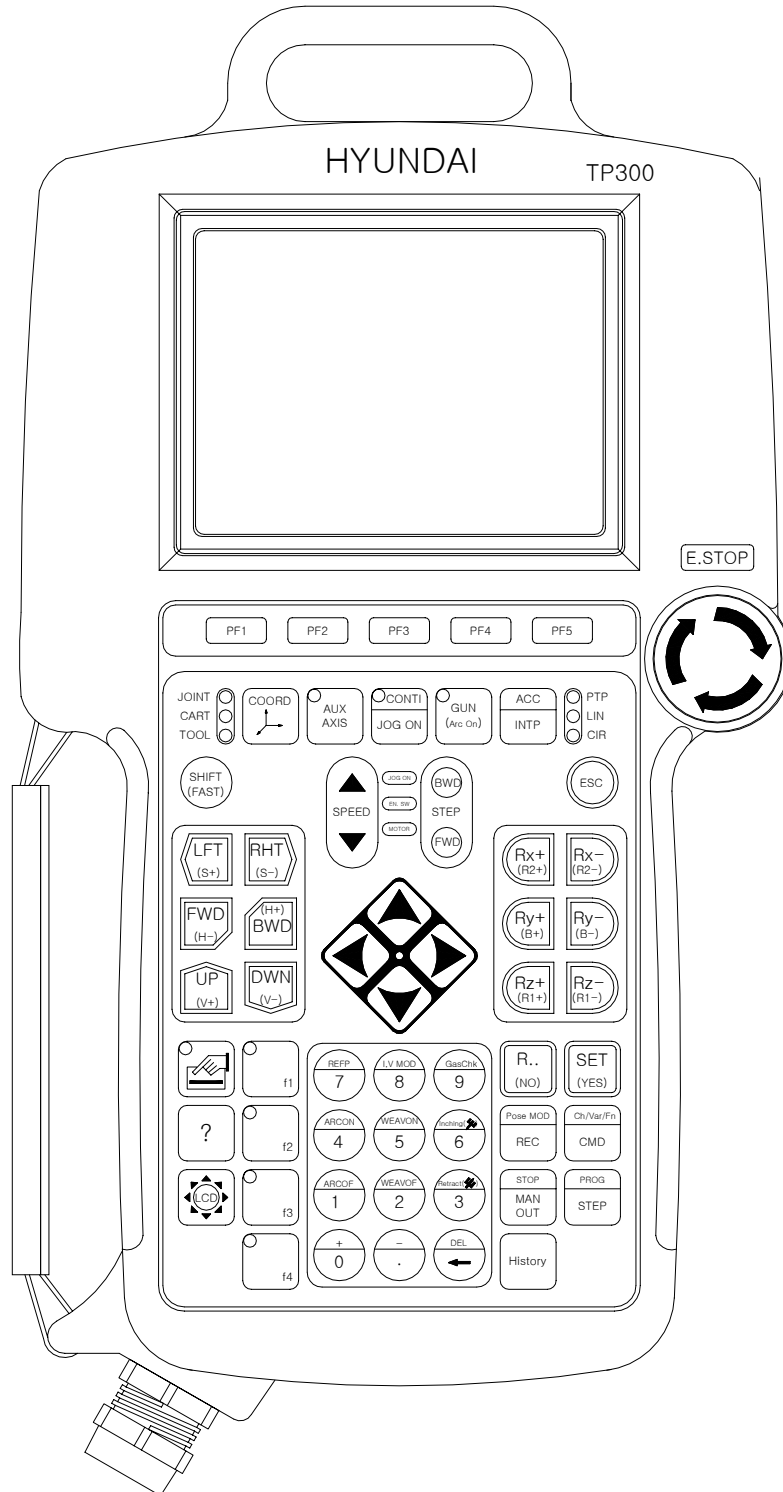
1.3.2 Screen of Teach Pendant

The following is an example display of teach pendant screen in case of manual mode.

```
14:39:38  *** M A N U A L ***   A:0 S:4      ←  Title Frame
T0
PN:999[*]__ S/F=3/0    Sp:100.00
     Robot:H120, 6axes, 4stpes
S1  .MOVE L,S=50%,A=0,T=0
S2  .MOVE L,S=50%,A=0,T=0
    .WEAVON WEV#=1
    .ARCON ASF#=1                            ←  Edit Frame
S3  MOVE L,S=40cm/min,A=0,T=0
    ARCOF AEF#=1
    WEAVOF
S4  MOVE L,S=50%,A=0,T=0
Select PF menu                               ←  Guide Frame
>_                                           ←  Input Frame
Service  System Rel.WAIT      Cond Set       ←  Menu Frame
```

Screen description

■ Title Frame: Current time (Hour: Minutes: Second:), Mode, Accuracy Level and Manual Speed are displayed.

■ Edit Frame: Program No., Step No., Function No., Speed, command message, position, condition file and etc. are displayed. Robot pattern, No. of axes and total step Nos. are displayed, in case of Step 0.

■ Guide Frame: Provide guide or instruction for user's operation. Errors or output messages of teach pendant is displayed.

■ Input Frame : The status of the data input from the teach pendant is displayed. Also, the range of the data to be input by user is displayed.

■ Menu Frame: It can be changed subject to any situations. Select one of the function keys from [PF1] to [PF5].

Reference

Highlighted message of S3 above means that current step No. is 3. '.' in front of each command before Step No. 3 means the command which was already implemented. Any commands after Step No. 3 mean not yet implemented.

_____

1.3.3 Keys of Teach Pendant

The followings are the explanation to any keys of teach pendant.

[E. STOP]
Use for emergency stop. When you press this key, motor will be off. For re-start operation, you can start only after making motor-on.

[PF Keys]
Use for select a menu at the menu-frame on the screen.
Press [PF1] to select the 1st menu item of the menu-frame on the screen.

[COORD]
When you press an axis operation key, the coordinate system (axis, cartesian or user, tool) which move robot is selected. The Coordinate System which is currently being selected is displayed on the upper LED.

[AUX AXIS]
You can select auxiliary axis operation. When you press [Left] [Right] [Front] [Rear] [Up] [Down] during light-up of LED, the auxiliary axis 1/2/3 are operated to the direction of front or rear.

[CONTI / JOG ON]
Select it when you want to operate robot in manual mode. When you press it after pressing [Motor-ON] Key of the operation panel, robot can be operated in manual mode and step go/back is also possible. When you press it together with [Shift(FAST)] simultaneously, you can select whether you want to implement it step by step or continuously during step go/back. The currently selected status is displayed at the upper LED.

[GUN (Arc on)]
After your step recording work, you can decide whether you will record the signal of GUN1 or not. When you press it together with [Shift(FAST)] simultaneously, the signal output of GUN1 is manually made. For Arc welding application, light-up of the same LED in playback mode means the actual arc welding operation is under processing. During turning-off the same LED in playback mode, no actual arc welding operation but the confirmation of the teached tracks is made.

[ACC / INTP]
You can select interpolation type(OFF, Linear, Circular) to be recorded during input of move command. The currently selected interpolation type is displayed at the upper LED. When you use it together with [Shift(FAST)] simultaneously, you can select position making level(0-3) to be recorded during the record of MOVE command. It is displayed at the upper

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right position of Title Frame.

[SHIFT(FAST)]
 You must use it only together with any of other keys. In order to implement the fuctions indicated in sky blue color at the upper part of keys, it must be pressed together with any of the sky blue color keys. When you press it together with Step Go/Back key simultaneously, the high speed moving function is implemented.

[ESC]
 You can use it if you want to cancel any key input or any status processing. And it also have further function to switch to upper level of PF Menu.

[Axis Operation Key]
 You can use it for the operation of axis.

[Direction Key]
 You can use it for changing Step or Function. When '+'mark at the right side of PF5 Menu is flickering, select the PF Menu at next page. When '+' mark at the right side of PF5 Menu is not indicating, move cursor of word within the below command. When you press it together with [Shift(FAST)] Key simultaneously, you can scroll the fixed display.

[SPEED]
 You can select not only the moving speed in manual operation but also the speed during recording MOVE command. Speed can be selected among totally 8 levels. When you press it together with [Shift(FAST)] simultaneously, shifting to highest or lowest speed is made.

[STEP FWD/BWD]
 You can use it when you want to move forward or backward step by step in manual mode. When you press it together with [Shift(FAST)] simultaneously, move the high moving speed previously assigned at condition assignment.

[User Key]
 The functions allocated by f-key arrangement are implemented.

 [QuickOpen]
 When you press it on the specific command, the "QuickOpen function" is implemented. The "QuickOpen function" is the function that can check and edit position data or any condition file on welding condition and weaving condition etc. (Part of QuickOpen Function - Refer to the Chapter 9) During the palyback mode, the shifting to Hot edit is made.

[?]
 Provide the relevant help message according to the each situation.

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[LCD]
When you press it together with [↑ /↓] Key simultaneously, you can control the brightness of LCD display.

[←] is BackSpace Key which can delete one by one the letters in front of the cursor. If you press this key during selection of any factors for editing command, the figures of factor selected will be deleted.

[Number Keys] : Input numbers.

[REFP] : Insert Reference Point Command

[I, V Change] : In Automatic Mode, first check welding current and voltage and further change it if necessary.

[GasChk]: Check whether gas gushes out actually.

[ARCON]: Insert the command of ARCON

[WEAVON]: Insert the command of WEAVON

[Inching]: Feed the welding wire.

[ARCOF]: Insert the command of ARCOF

[WEAVOF]: Insert the command of WEAVOF

[Retract]: Rewind the welding wire.

[DEL]: Delete any commands or factors. Program will be deleted at the position of program header(Step 0, Function 0).

[R..(NO)]: Use this key to input R Code or in need of "RESET" function or to select negative answer(No.) in case of requesting "Yes or No" answer.

[SET(Yes)]
Use this key to input command or in case of completion of data input. Contents of the input frame will be reflected to the Editing Frame. Also use this key to select positive answer "YES" in case of requesting "Yes or No" answer. As an additional function, you can use this key to modify the command in manual mode. When you press this key, the cursor covering the sentence will be changed the cursor covering word and at this time you can

----

edit the factor. If you press this key while cursor is located at row number, the number of row can be modified.

[Pose MOD/REC]
 Use this key to add "MOVE" command. The "MOVE" command to be recorded consists of the hidden PAUSE. (Refer to the Language Explanation Section in Chapter 11) When you press it together with [Shift(FAST)] key simultaneously, you can modify the position of the hidden pause MOVE command. For modifying factors other than position, you must use command modification.

[Ch/Var/Fn/CMD]
 Use this key to insert command. When you press it together with the Key[Shift(FAST)] simultaneously, you can input letters, variables or functions.

[STOP/MANOUT]
 Use this key to make output of "DO" Signal manually. When you press it together with [Shift(FAST)] key simultaneously, you can stop the implementation of payback mode.

[PROG/STEP]
 Use this key to stop the step. When you press it together with [Shift(FAST)] key simultaneously, any programs will be selected.

[History]
 Use this key to see the previous display.

Chapter 2. Basic operation

Contents

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Chapter 2. Basic operation of robot

2.1 Basic operation

Industrial robot is defined 『The machine that is capable of physical operation and manipulation by means of the automatic control and used by the industry by programming in the various tasks(JIS)』.

Most of the industrial robot uses Teaching and Playback mode. Teaching means "To instruct robot of the operation task" and Playback means "To carry out instructed work repeatedly". The operation method combining these two (Teaching and Playback) is also called as "Teaching & Playback Method".

2.1.1 Controller's power/motor ON/OFF

2.1.1.1 Power ON/ Motor ON

1. Confirm nobody in safety fence and no dangerous machine within robot's working area.

2. Turn power switch located at the upper left corner of the controller's front side to CW direction.

3. Push [Motor ON] switch on the operation panel.

4. Confirm whether [Motor ON] lamp is lighting up.

2.1.1.2 Power OFF/ Motor OFF

1. Push [STOP] button on the operation panel.

2. Turn [AUTO/MANUAL] switch on the operation panel to the MANUAL.

3. Push [Emergency Stop] button on teaching pendant or operation panel.

4. Turn power switch located at the upper left corner of controller's front side to CCW direction.

2.1.2　How to initiate the system

1. At manual mode, select "System"[PF2] → 5: System format → 1. System format. If you initialize the system, not only controller parameter file, machine parameter file, but also all kinds of files shall be deleted. Do not use it except system installation at first time.

2. Select the type of robot connected controller.

3. In case of additional axis, key in the number of axis and decide that whether conveyor synchronizing is "ON" or "OFF" and vibration control mode is "ON" or "OFF".

4. Turn the controller's power switch to "ON" form "OFF".

5. At manual mode, select "System"[PF2] → 3: Machine parameter → 5: Encoder offset calibration, then execute encoder offset calibration.

6. At motor "ON" status, after move robot to basic position, execute encoder offset calibration once more. This position data shall be used for encoder resetting when you change the motor.

7. Select program number 9999 and record one position step.

8. After selecting "MANUAL" mode and teaching automatic constant setting program, carry out optimizing axis constant and tool length function.

2.1.3 Teaching

1. Select "MANUAL" mode.

2. Select program number by pressing [Shift(FAST)]+[Prog].

3. Push [Motor On] key on the operation panel.

4. Push [JOG ON] key on the teaching pendant and confirm the LED is lighting up..

5. Move the robot using axis operation buttons and setup the moving condition such as record speed, interpolation type, accuracy etc.

6. Press [REC] key at the position that to be remembered.

7. Record the function.

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2.1.4 Step and Function

The position which is remembered by [REC] key or defined by a variable position data is named "STEP".

Working cannot be done by robot moving only. To carry out certain work, a signal communication which is confirming peripheral equipment's status and transmitting robot condition between robot and peripheral equipment is required. This kind of means for controller's signal exchange and handing is named "Function".

2.2 Basic things for step

Step is a word indicating robot's certain position (or tool's end position).

Robot basically, move to other step from this recorded step and carry out any other function.

Move command "MOVE" is a command language instructing robot's moving and it is a most basic command language in the robot programming. The position of tool end is recorded also various item such as speed, interpolation, accuracy are designated.

```
┌─────────┐
│  STEP   │──────────────┐
└─────────┘              │
 ○                       │
  ╲                      ▼
   ╲    ┌───────────────────────────────────────────────┐
┌──────────┐│14:39:38  *** M A N U A L ***   A:0 S:4      │
│Manipulator││T0                                          │
└──────────┘│ PNo:999[*]__  S/F:1/0    Spd:100.00         │
     ╲      │    Robot:H6, 6axes, 2steps                  │
      ▼     │S1   MOVE P,S=100mm/sec,A=0,T=0              │
 ○   ┌─────────┐│S2   MOVE L,S=100mm/sec,A=0,T=0            │
     │  STEP   │─────────│                                 │
     └─────────┘│                                          │
                │                                          │
                │Select PF menu                            │
                │>                                         │
                │Service  System Rel.WAIT       Cond Set   │
                └───────────────────────────────────────────┘
```
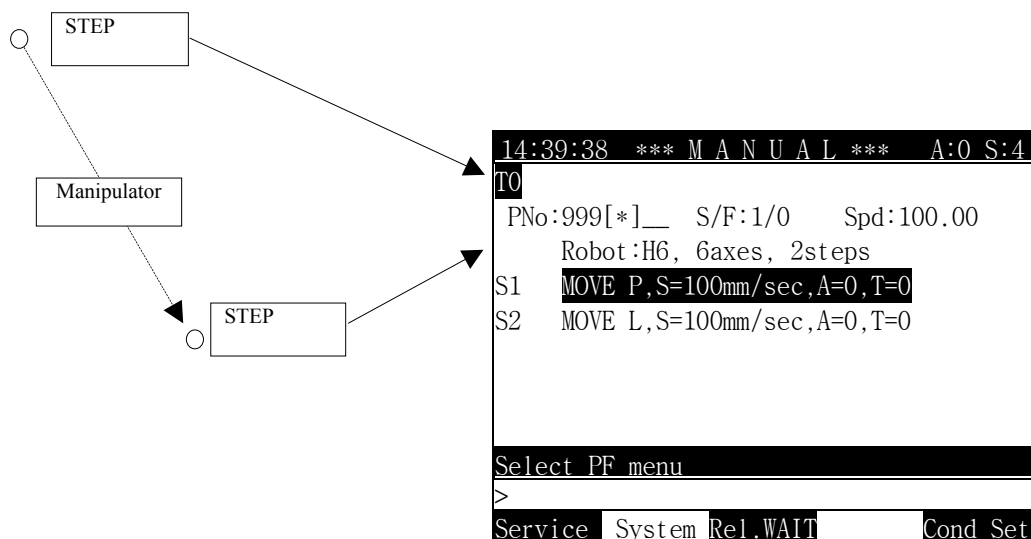
2.2.1 The parameter of STEP command line

```
MOVE  L,  P1,  S=100%,  A=0,  T=0,  G1,  MX1,  UNTIL I4,  V1%
      |   |    |        |     |      |    |        |          +- (8) Stop status
      |   |    |        |     |      |    |        +- (7) Stop condition
      |   |    |        |     |      |    +- (6) Output(Spot), BM(block mark)
      |   |    |        |     |      +- (5) Tool no. : 0~3
      |   |    |        |     +- (4) Accuracy : 0~3
      |   |    |        +- (3) Speed ( Unit : mm/sec, cm/min, %, sec )
      |   |    +- (2) Pose(X,Y,Z, Rx,Ry,Rz, Cfg){Coord.} + shift(X,Y,Z, Rx,Ry,Rz){Coord.}
      |   +- (1) interpolation : P(interpolation Off), L(liner), C(circular)
```

2.2.1.1 Interpolation - locus from between Step and Step

The interpolation method of [step n] decides the locus from between **[step n-1] and [step n]**..

■ P - interpolation off (point to point)
   It is used the section which is not concerning for the locus form of the tool-end (control point) movement to task point.

■ L - linear interpolation
   Move linear locus form between two step. It is used such as welding section which needs linear locus form. Tool and moves and changes the wrist pose automatically like in the bellow's drawing.
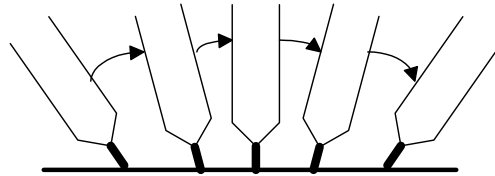
      Reference

1) Pose interpolation impossible condition
   - Near the deadzone of B axis
   - When the sign of B axis is changed.
   - When the angle variation of R1, R2 axis is over 180 deg.
       ⇨ It is varied according to interpolation execution method = <position interpolation, error stop> of B axis deadzone's designated item.
   - When the center of B axis or the end of tool is passing the circle center of S axis.
       ⇨ Locus form tolerance or error can be occurred.
   - When the angel variation of S axis is in excess of 180 deg.
       ⇨ Error is occurred certainly.

■ C - circle interpolation
   Move with circle locus form between two step. To make circle, 3 points are to be indicated. The standard is as follows.

   If the interpolation type is circle "C" when move to [step n+1] form [step n], look at next step [step n+2]. If the interpolation type of [step n+2] is also circle "C", the circle is made with [step n], [step n+1] and [step n+2]. Also robot moves following to arc of [step n] ~ [step n+1] section. If the interpolation type is not circle interpolation, the circle is made with [step n-1], [step n] and [step n+1] refer to previous step [step n-1].

   In case of an exception, if the interpolation type of [step 2] is "C" and the interpolation type of [step 3] is not "C", the last step [step n] must be referred to make circle.
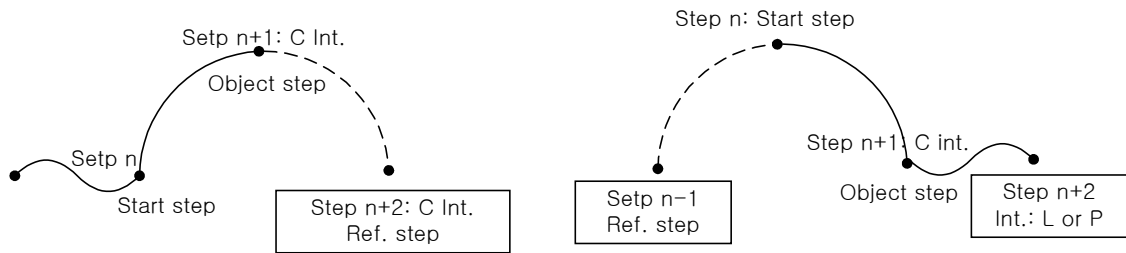
If you use the above explanation's standard, you can do programming using double registration of same point even in case of continuous circle.
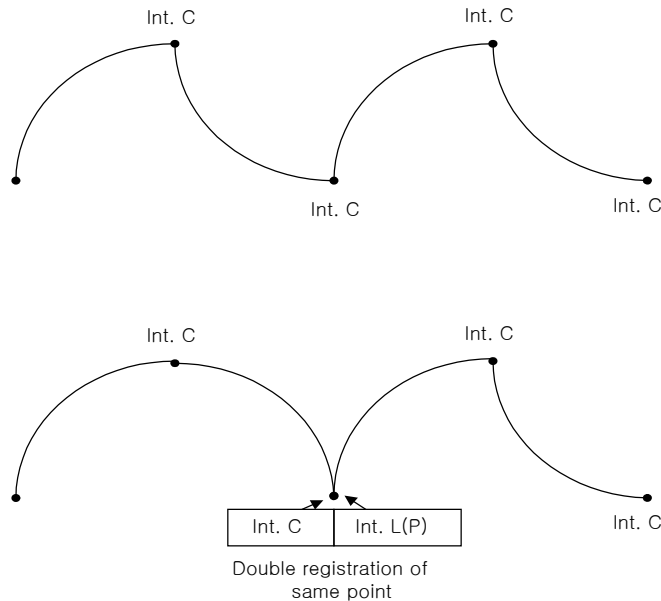
Like this, you can make program whatever your want. if your use double registration and decide the interpolation type of step considering the locus form to be made.

2.2.1.2 Pose

It is the parameter to record robot's position. In case of input of [MOVE] sentence using [CMD] key, you have to user pose parameter surely. In case of input of [MOVE] sentence pressing [REC] key, pose is not shown (hidden pose). In this case, the robot's position would be recorded as soon as you press [REC] key.

■ Pose : (X, Y, Z, Rx, Ry, Rz, Cfg) {coordinate system}
         {coordinate system} : ' '   = Base coordinate system
                              R = Robot coordinate system
                              E = Encoder

■ Shift : (X, Y, Z, Rx, Ry, Rz) {coordinate system}*) R1~R8 is same as in-line resister.
         {coordinate system} : ' '   = Base coordinate system
                              R = Robot coordinate system
                              T   = Tool coordinate system

2.2.1.3 Speed

Designate the speed of tool end. There are mm/sec, cm/min, sec, % etc n a unit. Sec designate speed as moving time, % is the ratio base on maximum speed.

2.2.1.4 Accuracy

Decide precision to pass the step (approach grade to recorded position) when the robot follow to recorded step. When the end of tool moves to object step, if the difference is uniform(accuracy O.K) between present position and recorded position, the robot moves to next step. Here, the difference is named accuracy. Accuracy 0 is most precision and accuracy 3 has the largest difference. This value can be defined in distance the number of bit at "System" [PF2] → 3: Machine parameter → 8: Accuracy.

Path of P2 accoring to accuracy
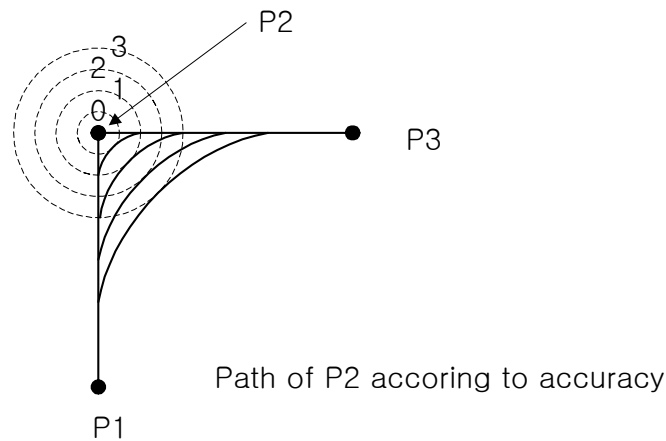
2.2.1.5 Tool number

The position of robot is decided by the pose and position of tool end. Designate the number of tool to be used.

2.2.1.6 Output option

G1, G2 - gun signal. - for spot welding.
MX1, MX2 - Maximum open. - for spot welding.
BM - block mark: At f key setting, speed 5% increase/decrease can be designated, when it if only adapted to move command designated BM.

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2.2.1.7 Stop condition

Execute next command (step or function) after stop robot's movement if satisfy the condition formula following UNTIL.

MOVE ... UNTIL I2=1

I2=1
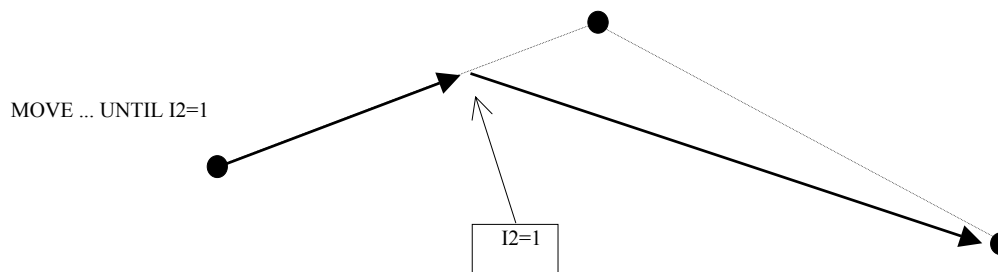
2.2.1.8 Stop state variable

Store the result value of stop condition formula. It shows whether the MOVE motion is completed or not in accordance with condition formula.

2.2.2 Step position validation/modification method

After move robot with axis operation keys, if press [REC] key on teach pendant can verify or modify robot's posture.

2.2.2.1 When the coordinate system is set as encoder

At manual mode, check the type of pose record from 'SYSTEM'[PF2] → 1 : User parameter → 2 : Default Pose. If the MOVE command's pose type is in a state of encoder, press then following screen will be displayed. For encoder setting robot posture, validation of location only can be done. You cannot modify position data.

```
14:39:38 *** Step Pose Data *** A:0 S:4
 POSE OF CURRENT STEP
  S :[  00400000]    T1:[  00400000]
  H :[  00400000]    T2:[  00400000]
  V :[  00400000]    T3:[  00400000]
  R2:[  00400000]
  B :[  00400000]
  R1:[  00400000]
 Coordination : <Base,Robot,Encoder>


 Press [Shift]+[<-][->] Key.
>
                                    Save
```

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2.2.2.2 When the coordinate system is set as Base or Robot

At manual mode, check the type of pose record from 'SYSTEM'[PF2] → 1 : User parameter → 2 :

Default Pose. If the MOVE command's pose type is in a state of Base or Robot, press 📝 then

following screen will be displayed. It shows that the robot configuration is designated as

'Define'.

```
14:39:38 *** Step Pose Data *** A:0 S:4
 POSE OF CURRENT STEP
  X: [      0.000] mm   T1: [    0.000] mm
  Y: [    880.000] mm   T2: [    0.000] mm
  Z: [   1020.000] mm   T3: [    0.000] mm
  Rx:[    -90.000] deg
  Ry:[      0.000] deg
  Rz:[      0.000] deg
 Coordination : <Base,Robot,Encoder>
 Robot Configuration: <Define,Self-Cfg>
  <Front,Rear> <Up,Down> <Flip,Non-flip>
 within |PI|: S=<Y,N> R1=<Y,N> R2=<Y,N>

 Select and Enter number. Press [SET]
 >[-99999.999 - 99999.999]
                                      Save
```

Reference

(1) Robot Configuration : When it need to record robot's position, there are multiple
solutions can be happened. To specify specific solution you should choose specific data
about robot style.

        bit 0 : (0 : Define , 1 : Self-Cfg)
        bit 1 : (0 : Front , 1 : Rear)
        bit 2 : (0 : Up , 1 : Down) → refer to following figure
                ⇒ related with H-axis and V-axis, all our robots are 'Up'.
        bit 3 : (0 : Flip , 1 : Non-flip)→ refer to following figure
        bit 4 : (0 : Left , 1 : Right) → on screen it will displayed as
                                ($| S| < 180, | S| = 180$)
                ⇒ All our robots are 'Left'.
        bit 5 : (0:| R2| <180, 1:| R2| >= 180) → It shows the location of R2-axis
        bit 6 : (0:| R1| <180, 1:| R1| >= 180) → It shows the location of R1-axis
        bit 7~9 : (0 : base, 1 : robot, 2 : reversed, 3 : encoder)
          → All those are about coordinate system for reference, It shall not be calculated.
          ⇒ For customer's convenience, coordinate systems are shall be added on the
             very end of letter.
        Base coordinate = (X,Y,Z,Rx,Ry,Rz,cfg)
        Robot coordinate = (X,Y,Z,Rx,Ry,Rz,cfg)
        Encoder = (S,H,V,R2,B,R1)

_____

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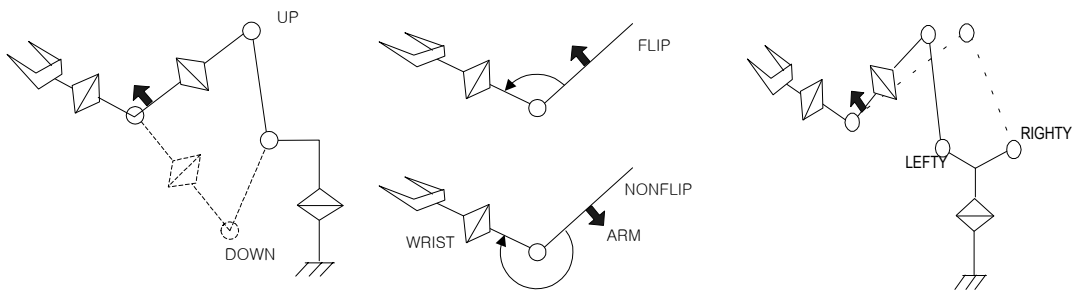
If the robot composition style is not set, the screen will be displayed as follow.

```
14:39:38 *** Step Pose Data *** A:0 S:4
 POSE OF CURRENT STEP
  X: [    50.000] mm   T1: [   0.000] mm
  Y: [   880.000] mm   T2: [   0.000] mm
  Z: [  1020.000] mm   T3: [   0.000] mm
  Rx:[   -90.000] deg
  Ry:[     0.000] deg
  Rz:[     0.000] deg
 Coordination : <Base, Robot,Encoder>
 Robot Configuration: <Define,Self-Cfg>


 Select and Enter number. Press [SET]
>[-99999.999 - 99999.999]
                                    Save
```

2.3 Coordinate system

2.3.1 JOG operation key

The following chart shows that the robot's moving direction in accordance with operation of JOG key for each Axis coordinate, Robot coordinate, User coordinate and Tool coordinate. It need to understand robot's movement according to coordinate system.

Action / Jog Key	[Coordinate System]			
	Axis coord.	Robot (Robt coord.)	Robot (User coord.)	Tool coord
Left(S+)	S [Left]	Xr (-)	Xu (-)	Xt (-)
Right(S-)	S [Right]	Xr (+)	Xu (+)	Xt (+)
Front(H-)	H [Front]	Yr (+)	Yu (+)	Yt (+)
Back우(H+)	H [Back]	Yr (-)	Yu (-)	Yt (-)
Up(V+)	V [Up]	Zr (+)	Zu (+)	Zt (+)
Down(V-)	V [Down]	Zr (-)	Zu (-)	Zt (-)
Rx+(R2+)	R2 [+]	Rxr (+)	Rxu (+)	Rxt (+)
Rx-(R2-)	R2 [-]	Rxr (-)	Rxu (-)	Rxt (-)
Ry+(B+)	B [+]	Ryr (+)	Ryu (+)	Ryt (+)
Ry-(B-)	B [-]	Ryr (-)	Ryu (-)	Ryt (-)
Rz+(R1+)	R1 [+]	Rzr (+)	Rzu (+)	Rzt (+)
Rz-(R1-)	R1 [-]	Rzr (-)	Rzu (-)	Rzt (-)

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2.3.2 Axis coordinate

On the state of Motor ON at manual mode, please check the JOG ON LED is lighted or not. When press down Coordinate system key on teach pendant, if the light is on at axis it can be move as operation of key. For the operation key, please refer to chart of 2.3.1 JOG operation key.
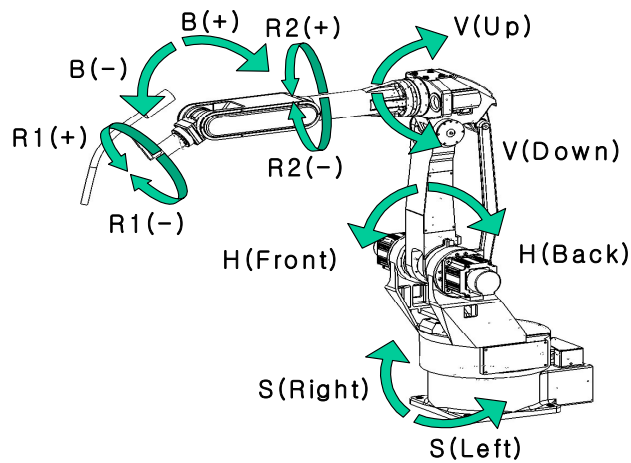
Axis Coord.

2.3.3 Robot coordinate

On the state of Motor ON at manual mode, please check the JOG ON LED is lighted or not. When press down Coordinate system key on teach pendant, if the light is on at cartesian it can be move as operation of key. For the operation key, please refer to chart of 2.3.1 JOG operation key.
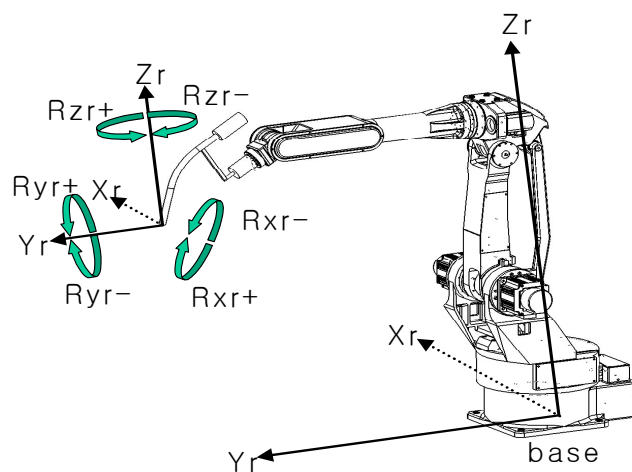
Robot Coord.

Reference

The following figure shows that how to determine the robot coordinate system. Stretch out left hand's three fingers ; thumb, point finger and middle finger at a right angle. It means that when the point finger's direction is aligned with Y-direction of robot coordinate, thumb's direction is pointing Z and point finger's direction is pointing X.

<Reference>

Axis direction

Rotation direction

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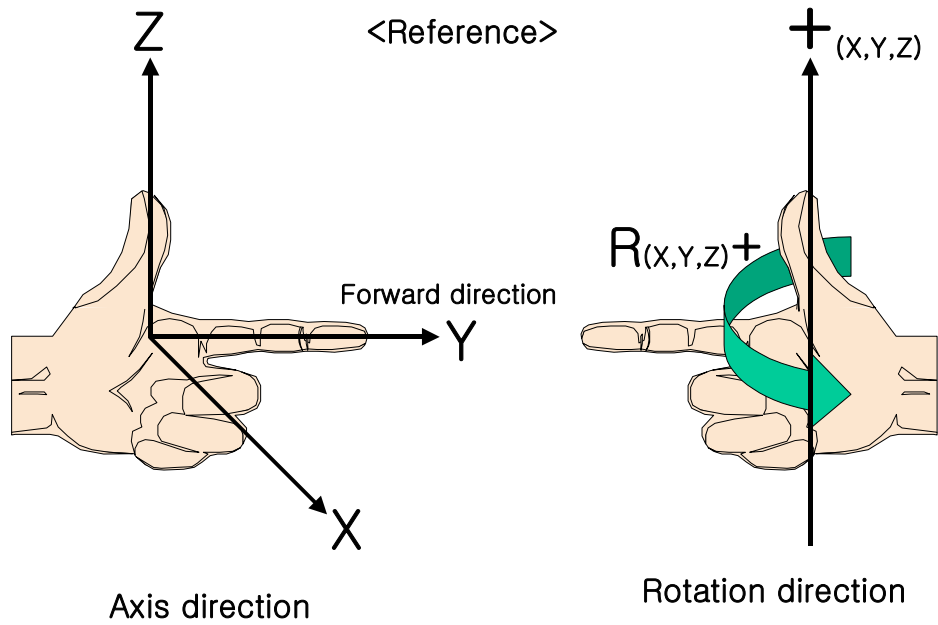
2.3.4 User coordinate

Select user coordinate from 'System'[PF2] → 2 : Controller parameter → 12 : Coordinate setting → 1 : User coordinate, and then set the selected coordinate. After that play the program under state of completion key in 'Cond Set'[PF5] → 8 : Select user coordinate, then robot shall move as following figure.

User Coor.
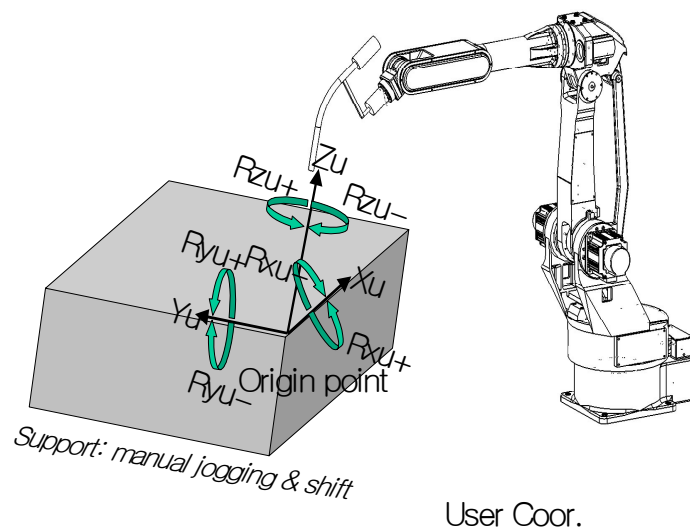
2.3.5 Tool coordinate

On the state of Motor ON at manual mode, please check the JOG ON LED is lighted or not. When press down Coordinate system key on teach pendant, if the light is on at tool. it can be move as operation of key. For the operation key, please refer to chart of 2.3.1 JOG operation key.
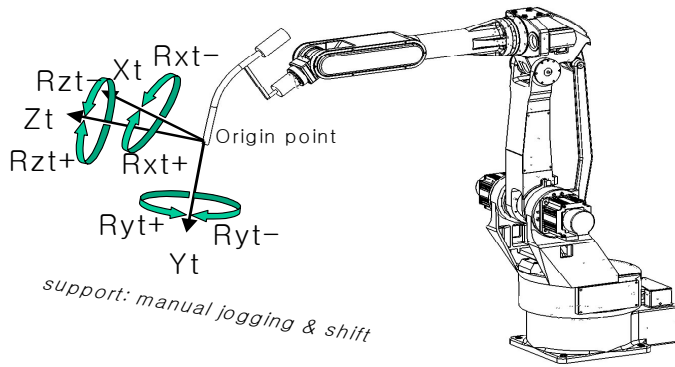
Tool coord.(with torch)

It shows that the robot is operating without tool.
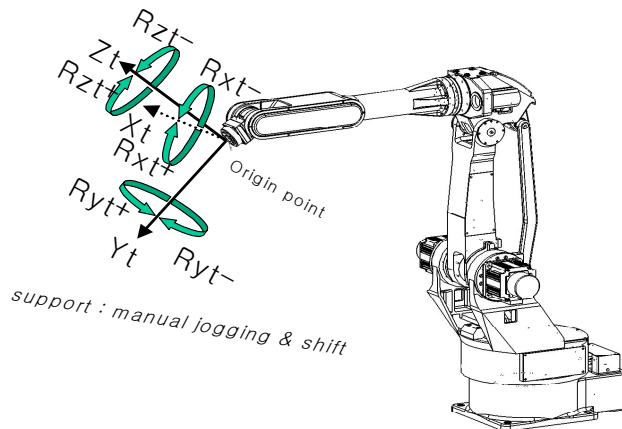
Tool coord.(without tool)

2.4 Auto tool setting

You can make the same program to the previous program by calibrating automatically the tool constant without teaching when the teaching point in the previous program is different from the previous teaching point resulting in changing, modification of the tool.

You can get angle, length of new tool if executing the function after moving the setting tool in the step that taught previously. At this time, The position data of the step that is taught is recorded as the pose data, accurate.

Press 'SYSTEM'[PF2] → 1 : User parameter → 2 : Default Pose then following screen will be displayed.

```
 14:39:38 ***AUTO TOOL SETg***  A:0 S:4
*) By jogging, place the tool-tip at
   the point of reference step, with the
   If the pose is not certain, execute
   'Angle Setting' after this function.


                        Program No. = [  0]
                           Step No. = [  0]
                           Tool No. = [  0]



 Select and Enter number. Press [SET]
 >[1 - 999]_
 ▮         ▮         ▮         Execute
```

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Chapter 3. Service Menu

Contents

Chapter 3 Service Menu

When you press the "Service [PF1]" on the Manual or Auto Mode. the following display contents appear.

```
14:39:38 ** Service contents **  A:0 S:4
1: Monitoring                       [R245]
2: Register setting
3: Variables
4: Program modify
5: File manager
6: Program conversion
7: System checking
8: Date setting(Day, Time)


Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```

3.1 Monitoring

Outline

It displays encoder value of each axis, degrees of angle, coordinates value data in/output condition. It is same as the code "R245 : Monitor mode selection"

Screen display

```
14:39:38  ***  Monitoring  ***    A:0 S:4
    0: Monitor OFF
    1: Axis data
    2: Private input
    3: Private output
    4: DIO(  1 - 24 )
    5: DIO( 25 - 48 )
    6: DIO( 49 - 72 )
    7: DIO( 73 - 96 )
    8: DIO( 97 - 120)
    9: DIO(121 - 144)
   10: DIO(145 - 168)
  ----------------------------------------
   11: DIO(169 - 192)
   12: DIO(193 - 216)
   13: DIO(217 - 240)
   14: DIO(241 - 256)
   15: Spot welding input/output monitor
   16: Brake slip count
   17: DIO Name display
   18: Conveyor data(with axis data)
   19: Analog data
   20: Servo GUN data
   21: Palletize register
  ----------------------------------------
   22: Equalizerless GUN data
   23: DSP analog monitor




  Use [Number]/[Up][Down] and press [SET].

  >

    Line          Previous  Next
```

Reference

■ When you select the "Line[PF1]", you can change the number of lines of monitoring
function on the display screen.

```
14:39:38  *** Monitoring ***   A:0 S:4

 How many monitoring lines?  [7]




Enter the number of line and press [SET]
>[2 - 7]
```

■ Input the number of Line of Monitoring screen display by number key, press [SET].
After you input the number and press the "Complete[PF5]" the display screen returns
back the " Monitoring "

■ You can see the following display screen when you select the number of Line "2" in
Manual Mode.

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
     Robot:H120, 6axes, 1steps
S1    MOVE P,S=100%,A=0,T=1




   Current  Command    Angle   Coor(mm)
S :040000   040000      0.0deg  X=   0.0


>
Service  System Rel.WAIT       Cond Set
```

■ You can see the following display screen when you select the number of Line "5" in
Manual Mode.

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
     Robot:H120, 6axes,  1steps
S1    MOVE P,S=100%,A=0,T=1



   Current  Command     Angle   Coor(mm)
S :040000   040000      0.0deg  X=   0.0
H :040000   040000     90.0deg  Y=   0.0
V :040000   040000      0.0deg  Z=   0.0
R2:040000   040000      0.0deg


>
Service  System Rel.WAIT       Cond Set
```

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3.1.0 Monitor OFF

Outline

It cancel the function of Monitoring that you already select.

3.1.1 Axis Data

Outline

It displays present encoder value of each axis, setting encoder value, degrees of angle, coordinates value. When you press the [Shift]↓ key, it displays the hidden item.

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
TO G1
PN:100[*]__  S/F=4/0    Sp:100.00
     Robot:H120, 6axes,  1steps
S1  MOVE P,S=100%,A=0,T=1
    Current Command     Angle    Coor(mm)
S :040000   040000      0.0deg  X=    0.0
H :040000   040000     90.0deg  Y=    0.0
V :040000   040000      0.0deg  Z=    0.0
R2:040000   040000      0.0deg
B :040000   040000      0.0deg
R1:040000   040000      0.0deg

>
Service  System Rel.WAIT       Cond Set
```

3.1.2 Private Input

Outline

It displays the status of the fixed input signal. When you input the present fixed input signal, it displays reverse indication. When you press the [Shift]↓key, it displays the hidden item.

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Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
      Robot:H120, 6axes,  1steps
S1   MOVE P,S=100%,A=0,T=1
 << Private Input Signal >>
Auto/Manual switch   Enable switch
Hard limit           ARM interference
Overlaod             Motor overheat
----------           Motor on(External)
MSHP on              MSPR ON
Emergency stop       ----------

>
Service  System Rel.WAIT        Cond Set
```

3.1.3 Private Output

Outline

It displays the status of the fixed output signal. When you input the present fixed output signal, it displays reverse indication. When you press the [Shift] key, it displays the hidden item.

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
      Robot:H120, 6axes,  1steps
S1   MOVE P,S=100%,A=0,T=1
 << Private Output Signal >>
Motors on(LED)       ----------
MSPR ON              MSPR ON
Start(LED)           ----------
Synthetic Err(LED) Stop(LED)
Hard limit release AUTO mode(Private)
----------           ----------

>
Service  System Rel.WAIT        Cond Set
```

3.1.4 DIO(1 - 24)
3.1.14 DIO(241 - 256)

Outline

It displays the status of common Input/Output.

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Screen display

The following screen displays when you select "4;DIO(1 - 24)".

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0   Sp:100.00
     Robot:H120, 6axes,  1steps
S1  MOVE P,S=100%,A=0,T=1
 << General I/O Signal >>
 I1   I2   I3   I4   I5   i6   I7   I8
 I9   I10  i11  I12  i13  I14  I15  I16
 I17  I18  I19  I20  I21  I22  I23  I24
 01   o2   03   04   05   06   o7   08
 09   o10  011  012  013  014  015  016
 017  018  019  020  021  022  023  024


>
Service  System Rel.WAIT        Cond Set
```

Reference

■ "System"[PF2] -> 2. Controller parameter -> 1. Setting input & output signal -> 7:
   Input signal assigning, 6: Output signal assigning Allocated signal displays small
   letter.
   ※ Not allocated signal : O5 , I14
   ※ Allocated signal   : o5 , i14

3.1.15 Spot welding Input/Output Monitor

Outline

It displays the status of the welding condition signal, GUN signal, MX signal,
Welding finish Input signal in spot welding..

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
     Robot:H120, 6axes,  1steps
S1   MOVE P,S=100%,A=0,T=1
 << Spot Welding I/O >>
 WELDg-Cond output  = 0 1 2 3 4 5 6 7
 Gun output         = 1 2
 MX output          = 1 2
 WI input           = 1 2


>
Service  System Rel.WAIT        Cond Set
```

3.1.16 Break Slip Count

Outline

You can select/ display the slip count value over the range and initialize it when you use in stud welding(Break ON type). You must select "System[PF2]" -> 5. System format -> 4: Setting usage of the robot, set the menu Stud in GUN1 or GUN2.

Screen display

```
14:39:38 * Slip count display * A:0 S:4
     1: Slip count display/setting
     2: Slip count reset




Use [Number]/[Up][Down] and press [SET].
>
```
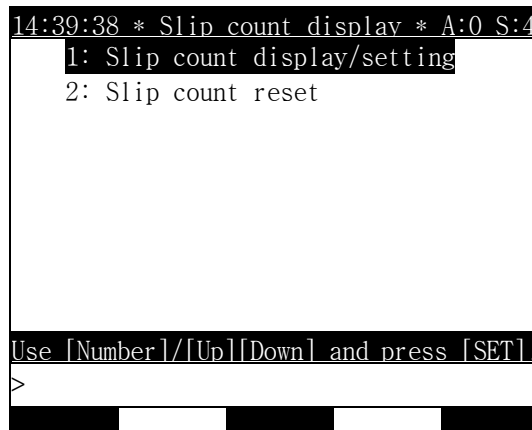
3.1.16.1 Slip Count display/setting

Outline

It displays the number of the break slip count in each axis and it is set the slip count by user. You must select " System[PF2] -> 5. System format -> 4: Setting usage of the robot, set the menu Stud in GUN1 or GUN2.

Screen display

```
14:39:38 * Slip count display * A:0 S:4
 S: [      0]    H :[      0]
 V: [      0]    R2:[      0]
 B: [      0]    R1:[      0]




Enter number and press [SET]
>[0 - 65535]
```

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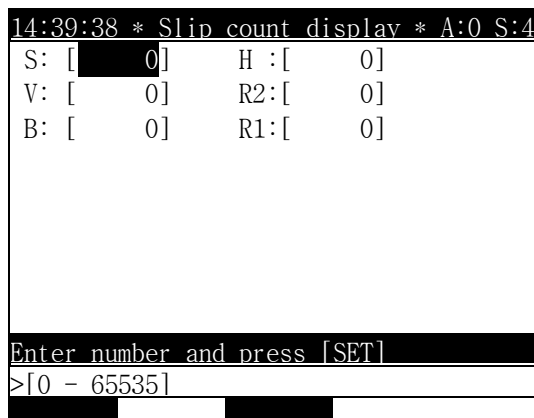
Operation method

Input the number of slip count by number key and press the [SET]. When the slip count of each axis are input, press the "Complete[PF5]"

3.1.16.2 Slip Count reset

Outline

It initialize slip count in all axis.

Screen display

The following message displays on the screen.

```
┌────────────────────────────────────────┐
│                                        │
│ Clear to slip count?          [YES/NO] │
│ >                                      │
│ ███████       ███████        ███████   │
└────────────────────────────────────────┘
```
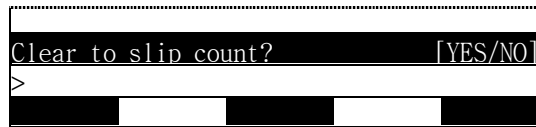
Operation method

When you select (YES), the slip count of all axis are 0 and initializes. When you select (NO), it cancels.

3.1.17 DIO name display

Outline

It confirms the Input/Output signal name. Monitoring of DIO name display is "System"[PF2] -> 2. Controller parameter -> 1. Setting input & output signal -> 9. Editing DIO names, Write DIO name in DIO name edit.

Screen display

```
┌────────────────────────────────────────┐
│14:39:38    ***  DIO name  ***  A:0 S:4 │
│   1: Page 1                            │
│   2: Page 2                            │
│   3: Page 3                            │
│   4: Page 4                            │
│                                        │
│                                        │
│                                        │
│ Use [Number]/[Up][Down] and press [SET].│
│ >                                      │
│ ███████    ███████    ███████          │
└────────────────────────────────────────┘
```
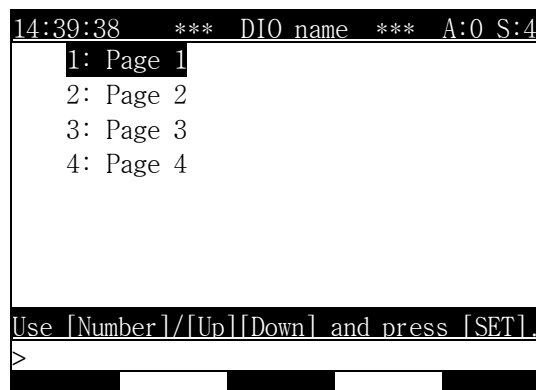
Operation method

When you select the page you want, the following screen displays the DIO name
monitoring.

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
      Robot:H120, 6axes,  1steps
S1  MOVE P,S=100%,A=0,T=1
<< DIO Name >>
 I1  : Clamp check    O1  : Clamp ON
 I2  : Collition sens O5  : Program END
 I8  : Ext. stop      O8  : Emergency
 I25 : Safety plug    O10 :
 _____      _____


>
Service  System Rel.WAIT      Cond Set
```

3.1.18 Conveyor Data (Included axis data)

Outline

When you use the conveyor, it displays the present encoder value of each axis, setting
encoder value, angle, coordinates, conveyor pulse count, conveyor register, conveyor
speed. Monitoring of Axis & Conveyor is "System"[PF2] ->5. System format -> 2.
Selecting type of the robot select and effective to use conveyor.

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
      Robot:H120, 6axes,  1steps
S1  MOVE P,S=100%,A=0,T=1
   Current  Command    Angle    Coor(mm)
 S :040000  0400C0   0.0deg   X=     0.0
 H :040000  0400C0  90.0deg   Y=     0.0
 V :040000  0400C0   0.0deg   Z=     0.0
R2 :040000  0400C0   0.0deg   CP=  12345
 B :040000  0400C0   0.0deg   CR=  500.7
R1 :040000  0400C0   0.0deg   CS=  100.0


>
Service  System Rel.WAIT      Cond Set
```

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3.1.19 Analog Data

Outline

It displays the input voltage, output voltage, speed of analog output for analog
port.

Screen display

```
14:39:38 *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
      Robot:H120, 6axes,  1steps
S1  MOVE P,S=100%,A=0,T=1
 << Analog signal I/O >>
          Port1   Port2   Port3   Port4
Input(V)  -12.0   -12.0   -12.0   -12.0
Output(V)   0.0     0.0     0.0     0.0
    => Proportional speed(mm/s):    0.0


>
Service  System Rel.WAIT        Cond Set
```

3.1.20 Servo GUN Data

Outline

When you use the servo GUN, it displays the encoder value, current, welding force
data for servo GUN, real inspection welding force in welding operation, distance
and wear amount between moving electrical pole and fixed electrical pole. You must
register the servo gun for additional axis for Servo gun axis data monitoring.

Screen display

```
14:39:38 *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0     Sp:100.00
      Robot:H120, 6axes,  1steps
S1  MOVE P,S=100%,A=0,T=1
<Servo GUN1 Data>    Current    Command
Axis encoder   => 00000000 : 00000000
Axis current   =>    0.00 :    0.00
Squeeze force  =>    0.00 :  350.00
   (Realistic squeeze force):    0.00
Length         =>    0.00 :    0.00
Consumption=>move: 0.00   fixed:  0.00


>
Service  System Rel.WAIT        Cond Set
```

3.1.21 Palletize Register

Outline

It displays the status of palletizing operation. It displays the status of
palletizing, pattern register number, counter,number of workpieces, and size of
workpiece. You must register the Palletizing for GUN2 for palletizing data monitoring.
"System"[PF2] -> 5. System format -> 4. Setting usage of the robot: GUN2: Palletizing

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0 G1
PN:100[*]__ S/F=4/0    Sp:100.00
     Robot:H120, 6axes,  1steps
S1 MOVE P,S=100%,A=0,T=1
 SFT+[<-][->]<Pa01> <Pa02> <Pa03> <Pa04>
Work state :    ON   OFF   OFF   OFF
Pattern Reg :    1     0     0     0
Counter    :    20     0     0     0
Total No.  :    80     0     0     0
Work size(X): 1000.0   0.0   0.0   0.0
Work size(Y): 1000.0   0.0   0.0   0.0


>
Service  System Rel.WAIT       Cond Set
```

Reference

(1) When you press the [Shift] ↓, [Shift] → key, it displays the hidden item.

3.1.22 Equalizeless GUN Data

Outline

When you use the eaqulizeless GUN, it displays the welding condition no., welding
force , 2-stroke data, in/output of welding- finish and wear amount of fixed
electrical pole. and fixed electrical pole. You must register the equalizeless gun
for GUN1 or GUN2 for equalizeless gun data monitoring. "System"[PF2] --> 5. System
format -> 4. Setting usage of the robot : GUN1 or GUN2: Spot and Air-GUN1 or Air-GUN
2 : EQ'less

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
TO G1
PN:100[*]__ S/F=4/0    Sp:100.00
     Robot:H120, 6axes, 1steps
S1    MOVE P,S=100%,A=0,T=1
<Equalizerless GUN Data>      Gun1   Gun2
Welding CND number(M33) =     002    xxx
Squeeze output          =      ON    OFF
Two step stroke output  =      ON    OFF
Welding compete input   =      ON    OFF
Fixed tip consumption   =     0.00   0.00


>
Service  System  Rel.WAIT      Cond.Set
```

3.2 Register

Outline

It displays / changes the XYZ shift register, Shift buffer, On line shift register group,
Palletize register, Frequency condition register.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
 1: XYZ shift register
 2: Shift buffer                [R162]
 3: ON-line shift register group
 4: Palletizing register
 5: Frequency condition register[R 18]
 6: Conveyor data


Use [Number]/[Up][Down] and press [SET].
>
                   Previous  Next
```

3.2.1 XYZ Shift Register

Outline

It is keeping the tool angle of point that is already taught and a parallel movement
in XYZ dimension. XYZ register reserves 3 dimension of shift data.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
# XYZ shift register

X=[      0.0]  Y=[     0.0]  Z=[     0.0]mm




Select and Enter number. Press [SET]
>[-3000.0 - 3000.0]
                              Complete
```
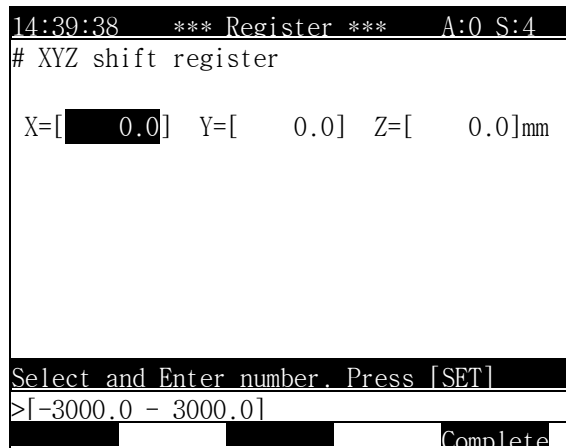
Operation method

■ After moving the cursor to changing the position, and press [SET] after inputting
  the numeric value with a numeric key.

■ If setting is ended, press 'Complete"[PF5] and the data is saved. If press 'Cancel"
  and it is canceled.

Reference

(1) Playback of XYZ shift function
      You must set the length in the direction of X,Y, and Z axis to the GUN -end exactly
    because translation is keeping the GUN angle.

(2) Application of XYZ shift function
    In case of translating the work parallel from the points A, B, C and D to the points
    a, b, c and d.
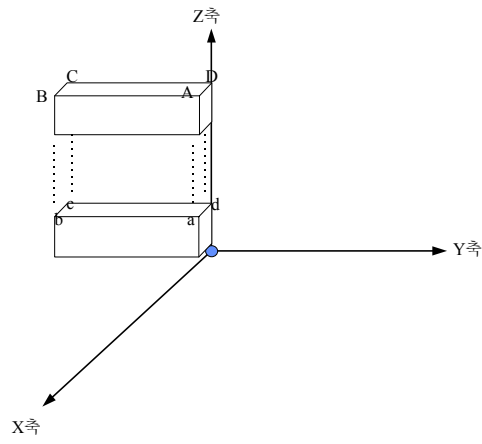
3.2.2 Shift buffers

Outline

It is a parallel movement with keeping up the tool angle that already taught.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
1. Shift buffer for robot coordinate
 X=[    0.0]  Y=[    0.0]  Z=[    0.0]mm
AX=[   0.00] AY=[   0.00] AZ=[   0.00]dg
2. Shift buffer for tool coordinate
 X=[    0.0]  Y=[    0.0]  Z=[    0.0]mm
AX=[   0.00] AY=[   0.00] AZ=[   0.00]dg




Select and Enter number. Press [SET]
>[-3000.0 - 3000.0]
                               Complete
```
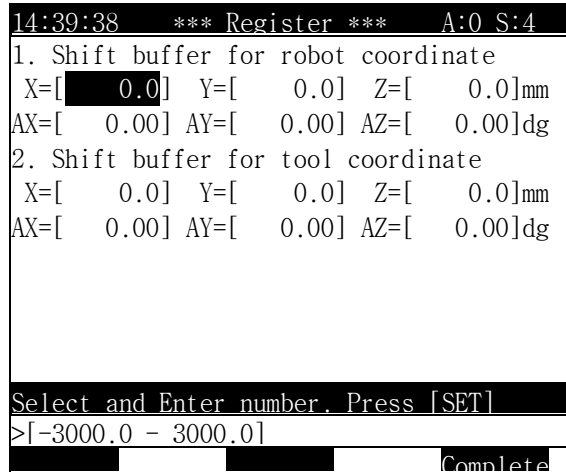
Reference

(1) Parallel movement shift

When the point of A, B, C, D and the points of a, b, c, d is a parallel movement relationship between its two positions. If playback to a position of a, b, c and d from the program of A, B, C and D with keeping up regularly the tool angle to a extent of different between the point and the point A from the external.
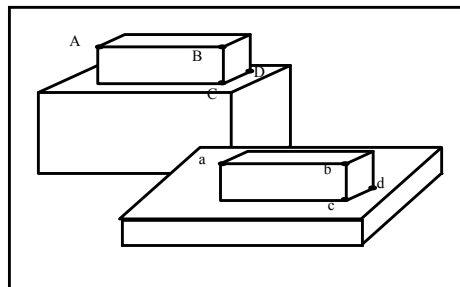
(2) Angle calibration shift

A parallel movement shift is a parallel movement with preserving the tool angle but an angle calibration shift make a shift while calibration correctly the tool angle on the basis of a deviating angle in the robot coordination system from the external. It can be playback regularly what is the tool angle for workpiece "A" is the point "c" as is the tool angle for workpiece "a" to the point "c".
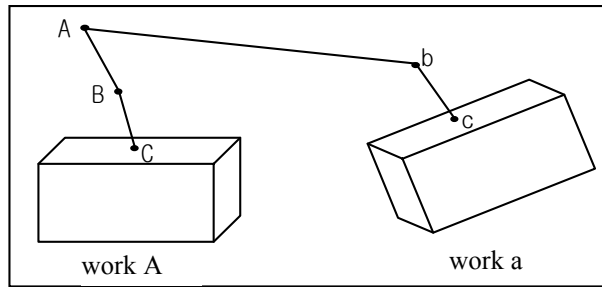
3.2.3 On-line shift register Group

Outline

On-line shift register group is a register that is set each axis length the palletize turning number, shift data to be received from the external unit. There are total 8 units. It can be set double register.

Screen display

```
14:39:38   *** Register ***   A:0 S:4
          1: ON-line shift register 1
          2: ON-line shift register 2
          3: ON-line shift register 3
          4: ON-line shift register 4
          5: ON-line shift register 5
          6: ON-line shift register 6
          7: ON-line shift register 7
          8: ON-line shift register 8

Use [Number]/[Up][Down] and press [SET].
>
```

Operation method

Select register group to set. If register group 1 selected, it displays as follow;

```
14:39:38   *** Register ***   A:0 S:4
# On-line shift register group
[Register1]
Request port No.=[0]  Input state=[0]
 X=[     0.0]  Y=[     0.0]  Z=[     0.0]mm
AX=[    0.00] AY=[    0.00] AZ=[    0.00]dg




Select and Enter number. Press [SET]
>[0 - 2]
                              Complete
```

Screen description

■ Request port No. : Input the number of serial port to be inputted from vision equipment

■ Input value : If the shift value from vision equipment inputted and changed position data, it changes to "1".

Reference

■ If set the on-line shift register clear as <ENBL>, from "Cond Set[PF5] -
   AppliCnd[PF1] - 7. Shift register clear" the value of on-line shift register shall
   be cleared to '0'.

3.2.4 Palletizing register

Outline

It can be set freely the content of a palletizing register.
It can be selected GUN2 from "System"[PF2] -> 5. System format -> 4. Setting usage of
 the robot.

Screen display

```
14:39:38    *** Register ***     A:0 S:4
 1: Palletizing register
 2: Palletizing preset
 3: Palletizing reset




Use [Number]/[Up][Down] and press [SET].
>


```
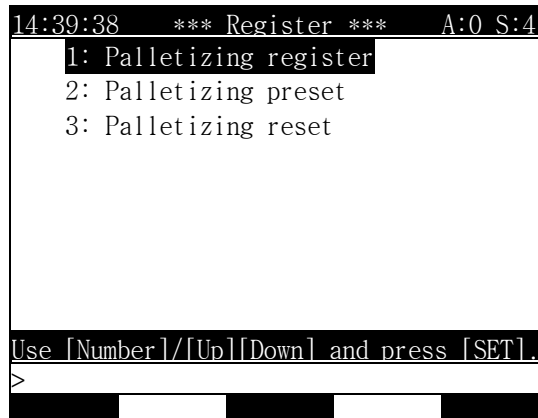
3.2.4.1 Palletizing Register

Outline

Set manually the shift data for palletizing.

Screen display

```
14:39:38    *** Register ***     A:0 S:4
# Palletizing register
1. Palletize shift data
 X=[     0.0]  Y=[    0.0]  Z=[    0.0]mm
AX=[   0.00] AY=[   0.00] AZ=[   0.00]dg
2. Picking up shift data
 X=[     0.0]  Y=[    0.0]  Z=[    0.0]mm



Select and Enter number. Press [SET]
>[-3000.0 - 3000.0]
                              Complete
```
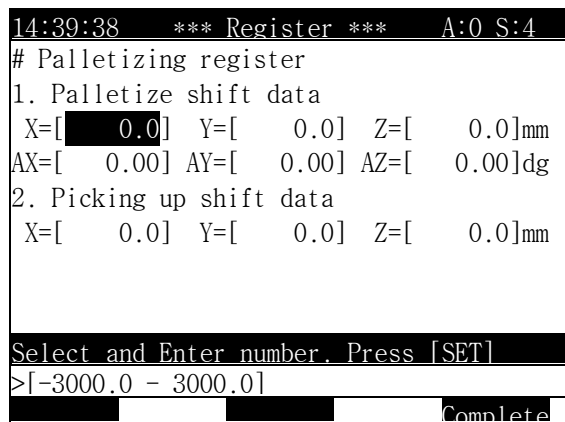
Screen description

■ Palletize Shift Data : Input shift data for palletizing.

■ Picking up Shift Data : Input shift data when lifting work piece.

※ To save changed data, press 'Complete'[PF5]. If press, [CANCEL], the data shall not
   be saved

3.2.4.2 Palletizing Preset

Outline

Preset the start number of the palletizing workpiece in advance.
It is the function to start robotic palletizing, under the state of pallet No.
palletizing pattern register No. and start No. are completed set by user.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
# Palletizing preset

Palletize pallet No           = [   0]
Palletize pattern register No. = [   0]
Start count                   = [   0]



Select and Enter number. Press [SET]
>[1 - 16]
```

Screen description

■ Palletize Pallet No : The number of pallet which will start work.

■ Palletize Pattern Register No. : Input number of pattern register which will start
   work.

■ Start Count : When it start work, input the counted number of workpiece among the
   total number of workpiece on the current pallet.

3.2.4.3 Palletizing Reset

Outline

Reset the value of the counter, palletizing register forcibly.

Operation method

If select "Palletizing Reset" item, it will be appeared on the screen as followings

```
Input the palletize pallet number.(1-16)
>[1 - 16]
```

■ If setting is ended, press [SET] key, it will be appeared on the screen as followings

```
End palletizing?                    [YES/NO]
>
```

■ If press [YES] key, it initialize the palletizing information, or press [NO] to cancel the work to do.

3.2.5 Frequency condition register

Outline

 It sets freely the content of frequency condition register.

 For example, when use those functions such as Step jump, Step call, Step return, Function assigned step jump, Program call, Program jump, Function jump, Target program call, etc. it compares with the value of frequency condition register to decide whether continue work or not.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
# Frequency condition register counter

   1=[   0]   2=[   0]   3=[   0]   4=[   0]
   5=[   0]   6=[   0]   7=[   0]   8=[   0]
   9=[   0]  10=[   0]  11=[   0]  12=[   0]
  13=[   0]  14=[   0]  15=[   0]  16=[   0]



Select and Enter number. Press [SET]
>[0 - 255]
                                      End
```

Operation method

■ After moving the cursor to changing position with direction key and press [SET] key
   after inputting a numeric value with a numeric key.

■ If press 'End'[PF5] key, changed data shall be stored. If press [CANCEL] key, the
   inputted data shall be cleared.

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3.2.6 Conveyor Data

Outline

You can set the CR parameter and simulation speed for conveyor simulation and you can check the conveyor data manual reset or quantity of workpiceses inline. You can set the conveyor data when you select "System"[PF2] -> 5. System format -> 2. Selecting type of the robot and select the Conveyor synchronization = <ON>.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
     1: Conveyor simulation data    [R 45]
     2: Conveyor data reset         [R 44]
     3: Current works' monitoring on C/V




Use [Number]/[Up][Down] and press [SET].
>
```

3.2.6.1 Conveyor Simulation Data

Outline

You can set the conveyor register(CR) and conveyor speed(CS) when you play the program in the simulation.

Screen display

```
14:39:38    *** Register ***    A:0 S:4
# Conveyor simulation data

Rgister (CR)    = [    0.0] mm
Speed (CS)      = [    0.0] mm/sec




Select and Enter number. Press [SET]
>[0.0 - 10000.0]
```

Screen Description

■ Register(CR) : Input the number of conveyor register.

■ Speed(CS) : Input the number of conveyor speed.

※ If press 'Complete'[PF5] key, changed data shall be stored. If press [CANCEL] key,
   the inputted data shall be cleared.

3.2.6.2 Conveyor Data Reset

   Outline

   Initialize the conveyor data register.

   Screen display

```
┌────────────────────────────────────────┐
│                                        │
│Conveyor data clear. Continue?  [YES/NO]│
│>                                       │
│████████      ████████      ████████    │
└────────────────────────────────────────┘
```
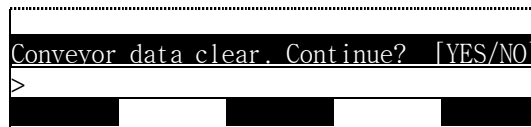
■ If you select the [YES], then you can initialize the conveyor data, and if you select
   [NO], then cancel it.

3.2.6.3 Monitoring for workpiece numbers on the conveyor

   Outline

   When there are many workpieces on the conveyor, you can monitor the number of
   workpieces.

   Screen display

```
┌────────────────────────────────────────┐
│14:39:38    *** Register ***    A:0 S:4 │
│                                        │
│ Works entered the CV line  = [ 3]      │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│████████████████████████████████████████│
│>                                       │
│████████      ████████      ████████    │
└────────────────────────────────────────┘
```
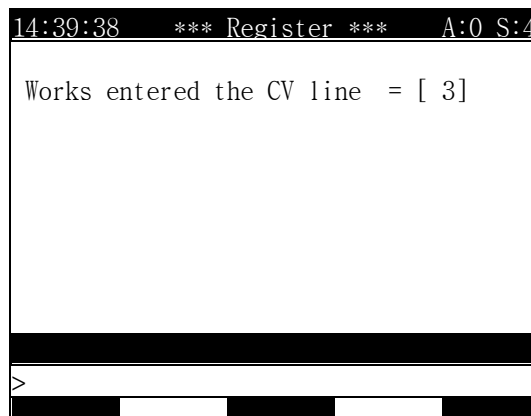
3.3 Variable

Outline

You can check or modify the present data of main variable and sub variable. Please refer to the "11. Robot Language -> 11.1.3. Variable" for more details.

Screen display

```
14:39:38*** Var. Monitoring *** A:0 S:4

   Select variable type to display.

              Global   Local
Integer        V%      LV%
  Real         V!      LV!
String         V$      LV$
  Pose         P       LP
Shift          R       LR


Select Var Type, Press [SET] or [PF5]
>
                                   Index
```
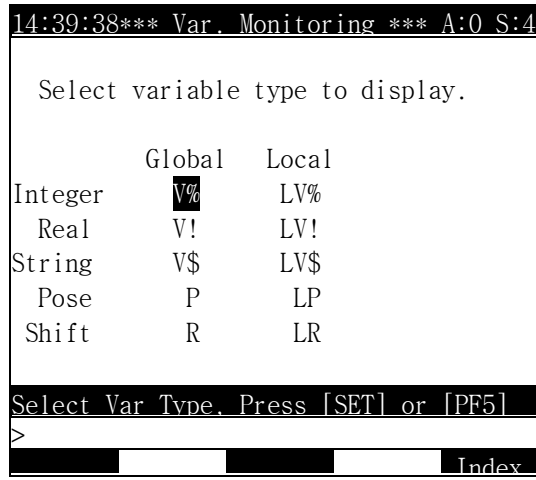
Operation Method

■ When you select the variable type by cursor and press the [SET]. The following display content is for selecting the constant variable type.

```
14:39:38*** Var. Monitoring *** A:0 S:4
 Var.    Data        Var.    Data
  V1%=[ 32519]        V2%=[ 21961]
  V3%=[  8232]        V4%=[  2130]
  V5%=[     0]        V6%=[     0]
  V7%=[     1]        V8%=[     0]
  V9%=[  8194]       V10%=[    31]
 V11%=[  4100]       V12%=[     0]
 V13%=[     1]       V14%=[     2]
 V15%=[ 17828]       V16%=[  -320]
 V17%=[-14671]       V18%=[    63]
 V19%=[-14448]       V20%=[    63]
Select and Enter number. Press [SET]
>
            Previous  Next  Index
```
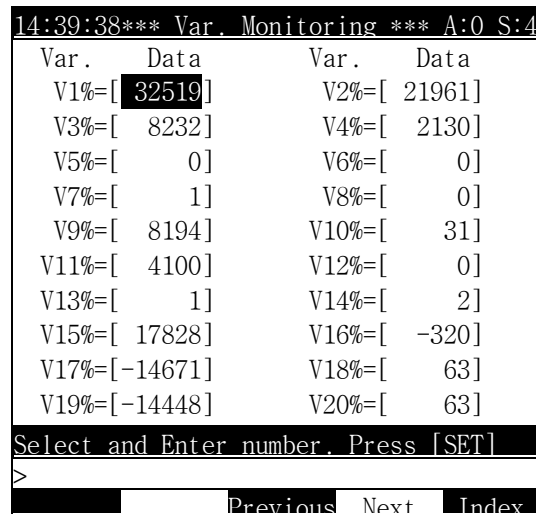
■ When you input the number of variable by keying the number and press the [SET].

3.4 Edit Program

Select the "Program modify" and then displays as follows.

```
14:39:38 *** Program modify *** A:0 S:4
1: Condition modify
2: Speed modify
3: Step position modify
4: Step copy
5: Reverse step copy
6: Hot edit


Use [Number]/[Up][Down] and press [SET].
>
            Previous  Next
```

3.4.1 Modify writing condition totally

Outline

You modify the condition in record of many steps in one program.

 Screen display

```
14:39:38 ** Condition modify ** A:0 S:4
Program No.  =[  5]
  Start step =[  1]    End step =[ 10]

  Accuracy    = < Const, 0, 1, 2, 3 >
  Tool        = < Const, 0, 1, 2, 3 >
  GUN 1       = < Const, Off, On >
  GUN 2       = < Const, Off, On >
  MX          = < Const, Off, On >
  MX2         = < Const, Off, On >

Select and Enter number. Press [SET]
>[1 - 999]
```
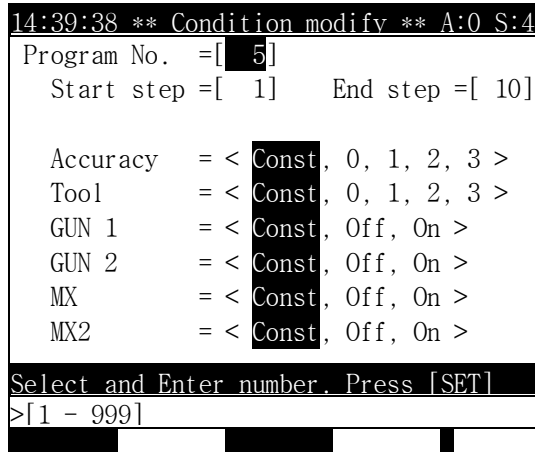
Display content

■ Program No: It is used to modify the condition in record in step. First value is
   present program number. Input the value when you need to modify it.

■ Start Step: It is the first step to modify the condition in record. First value
   of Start Step is set by 1. Input the value when you need to modify it.

■ End Step: It is the last step to modify the condition in record. First value of
   End Step is set by last step number of present program. Input the value when you
   need to modify it.

■ Accuracy, Tool, GUN1, GUN2, MX, MX2: Select the First Step and End Step by your
   request.

3.4.2 Modify speed in record totally

Outline

You modify the speed in record of many steps in one program.

Screen display

```
14:39:38** Speed Modification **A:0 S:4

Prog No. : [ 99]
Step :[  1] To [  9]
Mode :<Assign,Scale,Alter Unit>

Range:<All,Welding,Air-Cut,PTP,INT-On>
Unit :<mm/sec,cm/min,sec,%>

Spd/Ratio = [ 100.00]

Select and Enter number. Press [SET]
>[1 - 999]
```

Display content

■ Program No.: It is used to modify the speed in record. First value is present selected
   program number. Input the value when you need to modify it.

■ Step: It is the step range to modify speed in record. Range value of Step is First
   Step to Last Step. Input the value when you need to modify it.

■ Mode: Determine the mode of speed select
   ① Assign: Modify the speed in record totally.
   ② Scale: Modify the % value of speed in present step when the speed and the unit
      are same totally.
   ③ Alter Unit: Modify the unit of speed in record totally.

■ Range: Determine the range for modifying step

■ Unit: Modify the unit of speed in Speed Select and Unit Conversion. Modify the %
   value in Magnification Select.

■ Spd/Ratio: Modify the speed in Speed Select, and % value in Magnification Select.

3.4.3 Modify position in record totally

Outline

You modify the position in record of many steps in one program.

Screen display

```
14:39:38 ** Position modify ** A:0 S:4

 Program: [ 99]    Step:[  1] ~ [  9]
 Coord.fmt.:  <Cartesian,Axis>
(Hidden pose of the step is shifted.)


X =[     0]mm       T1=[      ]deg
Y =[     0]mm       T1=[      ]deg
Z =[     0]mm       T1=[      ]deg
RX=[     0]deg      T1=[      ]deg
RY=[     0]deg      T1=[      ]deg
RZ=[     0]deg      T1=[      ]deg
Select and Enter number. Press [SET]
>[1 - 999]
```

Display content

■ Program: It is used to modify the position in record. First value is present selected
   program number. Input the value when you need to modify it.

■ Step: It is the step range to modify position in record. Range value of Step is First
   Step to Last Step. Input the value when you need to modify it.

■ Coord. fmt.: Select the Cartesian type or Angular type to modify the position data
   recorded in step.
   ① Cartesian: Modify the position data in record according to the Cartesian type.
      Input the value in X,Y,Z, RX,RY,RZ,T1,T2,T3,T4,T5,T6.
   ② Axis : Modify the position data in record according to the angular type. Input
      the value in X,Y,Z, RX,RY,RZ,T1,T2,T3,T4,T5,T6. When you select the Angular type,
      Display contents as follows.

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```
14:39:38 ** Position modify ** A:0 S:4


Program: [ 99]    Step:[  1] ~ [  9]
Coord.fmt.:  <Cartesian,Axis>
(Hidden pose of the step is shifted.)


S =[ 100.0]deg     T1=[      ]deg
H =[ 100.0]deg     T1=[      ]deg
V =[ 100.0]deg     T1=[      ]deg
R2=[ 100.0]deg     T1=[      ]deg
B= [ 100.0]deg     T1=[      ]deg
R1=[ 100.0]deg     T1=[      ]deg
Select and Enter number. Press [SET]
>[1 - 999]
```

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3.4.4 Step Copy

Outline

You can copy the part of program or same program in the other program. This function make you can copy the function in the recorded step, The step numbers that selected by Jump or Call command are also changed automatically.

Example

This chart shows you can copy Step1 to Step 5 of the Program No.1 in the Step 2 of the Program No. 2.

Screen display

Reference

⑴ The end step No. of the program to copy is bigger than the start step No.

⑵ Input step No. of the program to be copied is the former step No.

⑶ When you copy the steps included the End point, the End function is also copied,
   On your request, you need to delete the end step.

⑷ You cannot copy the programs of Memory-protect or Program-protect.

⑸ When the Step-Jump, Call function are exist out of the range of the program to be
   copied, The Step No. are not changed. You must change the step No. after Copy-finish.

3.4.5 Step Reverse-Copy

Outline

You can copy the part of program or same program in the other program reversibly. This function make you can reverse-copy the function in the recorded step. The step numbers that selected by Jump or Call command are also changed automatically.

Example

This chart shows you can reverse-copy Step1 to Step 5 of the Program No.1 in the Step 2 of the Program No. 2.

Screen display

Reference

⑴ The end step No. of the program to copy is bigger than the start step No.

⑵ Input step No. of the program to be copied is the former step No.

⑶ When you copy the steps included the End point, the End function is also copied,
   On your request, you need to delete the end step.

⑷ You cannot copy the programs of Memory-protect or Program-protect.

⑸ When the Step-Jump , Call function are exist out of the range of the program to be
   copied, The Step No. are not changed. You must change the step No. after Copy-finish.

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3.4.6 Edit program in running (Hot Edit)

Outline

You can edit the program in the running mode like manual mode.

■ This function operates when the Robot is operating.

■ When you use this function if it is not the running mode, the following message is
  occurred.

```
┌──────────────────────────────────────┐
│                                      │
│ Not running state. Use MANUAL mode.[ESC] │
│ >                                    │
│ ███████  ███████  ███████            │
└──────────────────────────────────────┘
```
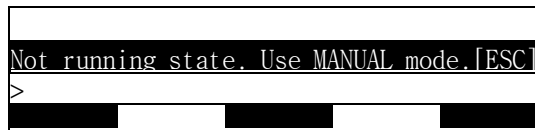
Reference

You can modify the program in running mode and you can operate the robot by the request
to accept modify the program, The robot moves as the modified program directly. You
must carefully the keep the attention not to break the jig by wrong modifying program.

3.4.3.1 In process

Outline

You can proceed in to the Hot Edit mode by 2 methods as follows. You can edit the
program in running program.

■ "Service"[PF1] -> 4. Program modify -> 6. Hot edit

■ Push the [⌨] key in robot running

Screen display

```
14:39:38   *** Hot edit ***   A:0 S:4
                              SR:100% Cont
HotE:022/3/1                   PB:022/4/0
S1    MOVE P,S=30%,A=1,T=0
S2    MOVE P,S=50%,A=0,T=0
S3    MOVE P,S=50%,A=0,T=0
      PRINT #1,"READY"
S4    MOVE P,S=50%,A=0,T=0
S5    MOVE P,S=50%,A=0,T=0
S6    MOVE P,S=50%,A=0,T=0
S7    MOVE P,S=50%,A=0,T=0

Select PF menu
>
              Escape  Apply   OK
```

3.4.3.2 Edit type

Outline

It is same as the manual mode, but the following functions are not used. When you
push the key, it does not't operate.
- Jog key
- [Record] key (Record of Hidden Pose MOVE)
- [Pose Mod] key
- [Delete] key in the program header

3.4.3.3 Accept

Outline

For the safety in Hot Edit, Permit the edit of the COPY PROGRAM instead of ORIGINAL
PROGRAM.

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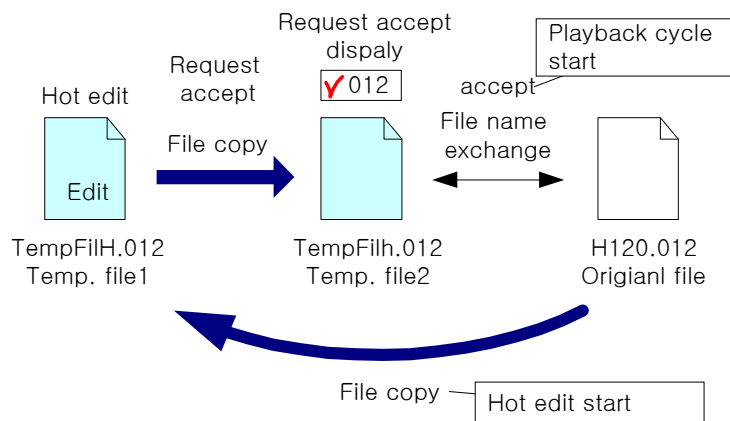
■ ORIGINAL PROGRAM is copied to the TEMP1 file and be modified by user. When user push the " OK" [PF5] key , TEMP1 is copied to TEMP2 and displays the request of Accept. Accept of ORIGINAL PROGRAM is proceeded by exchanging files between TEMP2 and ORIGINAL PROGRAM.

■ Accept are occurred to the following chart.

	Description	Accept time
Job processing	■ Practice the job ■ Job requested by CALL	Stating time of Re-cycle (Accept the all files)
	The other Job	On the request

■ Hot Edit cannot operates except running mode, But when the Stop function occurs by the user's request or other interrupt, it is possible to Request of Accept. But it is impossible to proceed Accept unless it starts by Re-cycle request.

■ When user push the [CMD] or [SET], [Delete] key in manual mode, the message occurs as follows. Do you want to proceed the Hot Edit at first? [Y/N]

```
┌──────────────────────────────────────┐
│                                      │
│ Apply hot edit, First ?    [YES/NO]  │
│ >                                    │
│ Service  System Rel.WAIT    Cond Set │
└──────────────────────────────────────┘
```

■ When you select the (YES), It is accepted. When you select the (NO), cancel the accept request and delete the TEMP2 file. If you select the Accept, it doesn't means new start of re-cycle. the present Job and content of job in stack are totally changed When you call the program, the problem can be occurred. The Call stack is cleared and the following message occurs.

```
┌──────────────────────────────────────┐
│                                      │
│ Applying initiated CALLing info.     │
│ >                                    │
│          Escape  Apply    OK         │
└──────────────────────────────────────┘
```

■ When you operate the PLAY in the condition of Call Stack cleared, it can be abnormal operation of CALL function.

3.4.3.4 Confirm, Accept, Cancel

Outline

There are 3 types of Confirm, Accept, Cancel in PF menu in Hot Edit.

Function

■ When you push the "OK"[PF5], the message occurs "Do you want to Save?" When you
   push (YES), Contents of Hot Edit is accepted Original file and Hot Edit is finished.

■ When you push the "Apply"[PF4], the message occurs "Do you want to Save?" When you
   push (YES), Contents of Hot Edit is accepted Original file.

■ When you push the "Escape"[PF3], the message occurs "Do you want to Cancel?" When
   you push (YES), Hot Edit is finished.

3.4.3.5 Program Counter Information

Outline

No.2 frame(3rd paragraph) of Teaching Pendant Display are displayed as follows.

■ HotE : position of cursor to use edit in the Hot Edit mode.
         (program no., step no., function no.)

■ PB : program counter in playback mode
       (program no., step no., function no.)

■ ' * ' : Modify or Not-Modify status from Original file

■ ' ▶ '   : Request or Not-Request from Original file

```
14:39:38   ***   Hotedit   ***   A:0 S:4
                              SR:100% Cont
HotE:022/3/1            *▶ PB:022/4/0
S1    MOVE P,S=30%,A=1,T=0
```

3.4.3.6 Select other program

Outline

When you push the [Program] key, you can select the other program.

■ When the program selected is not exist or the axis selected is different, the error
message is occurs and the operation is stopped. When the program selected is exist
and the program is modified, the message " Do you want to Save ?" When you push (YES),
the program is saved and call the selected-program and display it. When you push
(NO), the program is not saved and call the selected-program and display it.

■ You can not select the no-existing program, and the following message of No Program
is displayed in No.2 Frame.

```
14:39:38   *** Hot eidt   ***   A:0 S:4
                               SR:100% Cont
HotE:011[ ]            *▶ PB:022/4/0
```

3.5 File Management

When you select File management, the following display occurs.

```
14:39:38  *** File manager ***  A:0 S:4
  1: Show file names in memory    [R 17]
  2: Show the headline of program[R107]
  3: Show the number of axes for Prog.
  4: Rename                       [R116]
  5: Copy                         [R115]
  6: Delete                       [R117]
  7: Protect                      [R269]
  8: Storage media format
  9: Save/load all files. (SRAM card)


Use [Number]/[Up][Down] and press [SET].
>
                    Previous  Next
```

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3.5.1 Internal memory file name

Outline

It displays file name, file content, no. of step in the internal memory.

Operation method

When you select the file name, the following message occurs.

```
All files? [Yes], or just programs? [No]
>
```

■ When you select (YES) key, you can see the information of all files. And when you select
   (No), you can see the program file only. The following display are occurs when you
   select the (Yes).

```
14:39:38  *** File display ***  A:0 S:4
  {Name}       {Contents}          {Step}
H120    .990 'Spot 1                    8
H120    .991 'Spot 2                   18
H120    .992 'Spot 3                   20
H120    .993 '???                      22
H120    .994 '???                      24
ROBOT   .C00 'Control Const file
ROBOT   .C01 'Machine Const file
ROBOT   .E01 'Error logging file
ROBOT   .S01 'Stop logging file
ROBOT   .TR0 'Operation Hist file
 15 file, 31351 Block free.  Page[ 1/ 2]
>
               Previous  Next  Escape
```

Display content

■ File name: Program file, Integer file, History of event Program name is consisted
   of robot type and program no.

■ File content: When the remark of step 0 is exist, the contents of remark is displayed.
   When there is not the content of remark, it is displayed '???'

■ No. of step: The number of total steps in program file.

3.5.2 Program first data

Outline

It displays the remark of step 0., And when there is not remark data in step 0, it displays the remark content of step 1.

Screen display

```
14:39:38  *** M A N U A L ***   A:0 S:4
T0
PN:100[*]__ S/F:4/0     Sp:100.00

PNo: Content of head data -------------
992: Main program
993: SPOT 1
994: MOVE P,S=100.00mm/sec,A=0,T=0
995: MOVE P,S=100.00mm/sec,A=0,T=0


Use cursor Up/Down, then [ESC] for exit.
>
Service  System Rel.WAIT       Cond Set
```

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3.5.3 Internal program axis no.

Outline

It displays the integer, history in internal memory and robot name, no. of axis, total steps, file content in Program file

Screen display

```
14:39:38 *** Number of axes *** A:0 S:4
    1: Internal memory
    8: SRAM card




Use [Number]/[Up][Down] and press [SET].
>
```

■ When you "1. Internal memory", the following display occurs.

```
14:39:38  ***   Axes(RAM)   *** A:0 S:4
ROBOT.C00 Controller constant file
ROBOT.C01 ROBOT constant file
ROBOT.E01 Error logging file
ROBOT.FBU Fieldbus data file
ROBOT.S01 Stop logging file
ROBOT.TR0 Operation history file
H120.996(6Ax,5Step) MOVE P,S=20.00%,A=0,
H120.997(6Ax,8Step) MOVE P,S=20.00%,A=0,
H120.999(6Ax,10Step) MOVE P,S=20.00%,A=0

  9 file, 63156 block free.  Page[ 1/ 1]
>
            Previous  Next  Escape
```

3.5.4 Rename

Outline

You can use this function to change the file number. Rename can be changed all the
internal memory and file of SRAM card and all information (date, type...) are exist.
You can change the Rename about the protected files.

Screen display

```
14:39:38    ***  Rename  ***    A:0 S:4
 1: Internal memory
 8: SRAM card




Use [Number]/[Up][Down] and press [SET].
>
```

■ When you "1. Internal memory", the following display occurs.

```
14:39:38    *** Rename(RAM) ***   A:0 S:4
H120    .991   31   2001-07-09 13:34__
 H120    .992   31   2001-07-09 13:34__
H120    .993   31   2001-07-09 13:34__
 H120    .994   31   2001-07-09 13:34__
 H120    .995   31   2001-07-09 13:34__
 ROBOT   .C00   78   2001-06-30 11:12__
 ROBOT   .C01   67   2001-06-30 11:12__
 ROBOT   .E01   93   2001-06-30 11:12__
 ROBOT   .IM0   10   2001-06-30 11:12__
 ROBOT   .S01  561   2001-06-30 11:12__
 ROBOT   .TR0  101   2001-06-30 11:12__
15 file, 31351 Block free, Page[ 1/ 2]
>
 Select  Cancel Previous  Next  Execute
```

Operation Method

■ Select the file, Push "Execute"[PF5]. Refer to select the file as follows. For example,
   Select "991" program and Push the "Execute"[PF5] is as follows.

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```
14:39:38   *** Rename(RAM) ***  A:0 S:4
H120     *991   31    2001-07-09 13:34__
H120     .992   31    2001-07-09 13:34__
H120     .993   31    2001-07-09 13:34__




Enter new No and press [SET]
>[1 - 999]
 Select  Cancel Previous  Next   Execute
```

■ Input new no. and Press [SET]

 File Select Method

1) Individual select

   Select the file individually. When you move the file by cursor and press [SET] key,
   the file is selected or canceled reversibly.

```
14:39:38   *** Rename(RAM) ***  A:0 S:4
H120     .991   31    2001-07-09 13:34__
H120     .992   31    2001-07-09 13:34__
H120     .993   31    2001-07-09 13:34__

 15 file, 31351 Block free, Page[ 1/ 2]
>
 Select  Cancel Previous  Next   Execute
```

And Next Display, when you press [SET] key, '*' of "H120.991" selected file appears.

```
14:39:38   *** Rename(RAM) ***  A:0 S:4
H120     *991   31    2001-07-09 13:34__
H120     .992   31    2001-07-09 13:34__
H120     .993   31    2001-07-09 13:34__

 15 file, 31351 Block free, Page[ 1/ 2]
>
 Select  Cancel Previous  Next   Execute
```

2) Group Select

   Select the file by group. When you press "Select"[PF1] or "Cancel"[PF2} key, it is
   displayed the "Kinds of Group select". When you press "Select"[PF1], you select "Group
   select". When you press "Cancel"[PF2], you select "Select Cancel". The following
   displays Group Select.

```
Use PF Key and select.
>
 All fileAll ProgAll LogSeparateComplete
```

■ When you select " All file"[PF1], you can select all files.

```
14:39:38   *** Rename(RAM) ***   A:0 S:4
H120    *991   31   2001-07-09 13:34__
H120    *992   31   2001-07-09 13:34__
H120    *993   31   2001-07-09 13:34__
H120    *994   31   2001-07-09 13:34__
H120    *995   31   2001-07-09 13:34__
ROBOT   *C00   78   2001-06-30 11:12__
ROBOT   *C01   67   2001-06-30 11:12__
ROBOT   *E01   93   2001-06-30 11:12__
ROBOT   *IM0   10   2001-06-30 11:12__
ROBOT   *TR0  101   2001-06-30 11:12__
 15 file, 31351 Block free, Page[ 1/ 2]
>
 Select  Cancel Previous  Next   Execute
```

■ When you select " All Prog"[PF2], you can select program file only..

```
14:39:38   *** Rename(RAM) ***   A:0 S:4
H120    *991   31   2001-07-09 13:34__
H120    *992   31   2001-07-09 13:34__
H120    *993   31   2001-07-09 13:34__
H120    *994   31   2001-07-09 13:34__
H120    *995   31   2001-07-09 13:34__
ROBOT   .C00   78   2001-06-30 11:12__
ROBOT   .C01   67   2001-06-30 11:12__
ROBOT   .E01   93   2001-06-30 11:12__
ROBOT   .IM0   10   2001-06-30 11:12__
ROBOT   .S01  561   2001-06-30 11:12__
ROBOT   .TR0  101   2001-06-30 11:12__
 15 file, 31351 Block free, Page[ 1/ 2]
>
 Select  Cancel Previous  Next   Execute
```

■ When you select " All log"[PF3], you can select all history files..

```
14:39:38   *** Rename(RAM) ***   A:0 S:4
H120    .991   31   2001-07-09 13:34__
H120    .992   31   2001-07-09 13:34__
H120    .993   31   2001-07-09 13:34__
H120    .994   31   2001-07-09 13:34__
H120    .995   31   2001-07-09 13:34__
ROBOT   .C00   78   2001-06-30 11:12__
ROBOT   .C01   67   2001-06-30 11:12__
ROBOT   *E01   93   2001-06-30 11:12__
ROBOT   *IM0   10   2001-06-30 11:12__
ROBOT   *S01  561   2001-06-30 11:12__
ROBOT   *TR0  101   2001-06-30 11:12__
 15 file, 31351 Block free, Page[ 1/ 2]
>
 Select  Cancel Previous  Next   Execute
```

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■ When you select " Separate"[PF4], you can select '1) select' select.

3) Direct input

 You input the direct program No. and select it. If you know the program no. to be selected, you press [Shift] [Program/Step] key and input the program no.. Then press [SET] key, you can select or cancel the program file.

3.5.5 Copy

Outline

File can be copied from storage device to the others or to itself. File that has been copied does not have attribute. Time of file being copied is current time (Date can not be copied) Copy can be possible for the file of internal memory and SRAM card.

Screen display

```
14:39:38      *** Copy ***      A:0 S:4
      1: Internal memory
      8: SRAM card




Use [Number]/[Up][Down] and press [SET].
>

```

Operation method

■ 1: The following is displayed as selecting internal memory.

```
14:39:38    *** Copy(RAM) ***   A:0 S:4
H120   .991   31   2001-07-09 13:34__
H120   .992   31   2001-07-09 13:34__
H120   .993   31   2001-07-09 13:34__
ROBOT  .C00   78   2001-06-30 11:12__
ROBOT  .C01   67   2001-06-30 11:12__
ROBOT  .E01   93   2001-06-30 11:12__
ROBOT  .IM0   10   2001-06-30 11:12__
ROBOT  .S01  561   2001-06-30 11:12__
ROBOT  .TR0  101   2001-06-30 11:12__

8 file, 62094 block free.  Page[ 1/ 1]
>
Select  Cancel Previous  Next  Execute
```

■ Select file and press " Execute" [PF5]. Refer to the above method to select file. Example is when selecting program "991"and pressing "Execute"[PF5].

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```
14:39:38   *** Copy(RAM) ***   A:0 S:4
H120    *991   31    2001-07-09 13:34__
H120    .992   31    2001-07-09 13:34__
H120    .993   31    2001-07-09 13:34__
ROBOT   .C00   78    2001-06-30 11:12__
ROBOT   .C01   67    2001-06-30 11:12__
ROBOT   .E01   93    2001-06-30 11:12__
ROBOT   .IM0   10    2001-06-30 11:12__
ROBOT   .S01   561   2001-06-30 11:12__
ROBOT   .TR0   101   2001-06-30 11:12__


Where? (1:Internal Memory / 8:SRAM Card)
>
 Select  Cancel  Previous   Next  Excute
```

■ Select either internal memory or SRAM card, Press [SET]key. The following is displayed as selecting internal memory

```
14:39:38   *** Copy(RAM) ***   A:0 S:4
H120    *991   31    2001-07-09 13:34__
H120    .992   31    2001-07-09 13:34__
H120    .993   31    2001-07-09 13:34__







Enter new No and press [SET].
>[1 - 999]
 Select  Cancel Previous   Next   Execute
```

■ Enter new number and press [SET] to execute copy.

3.5.6 Delete

Outline

Function to delete selected file. File delete can be carried out for the all files of
internal memory and SRAM card. However files of full or partial protection can not be
deleted.

Screen display

```
14:39:38        *** Delete ***        A:0 S:4
      1: Internal memory
      8: SRAM card




 

 

Use [Number]/[Up][Down] and press [SET].
>
```
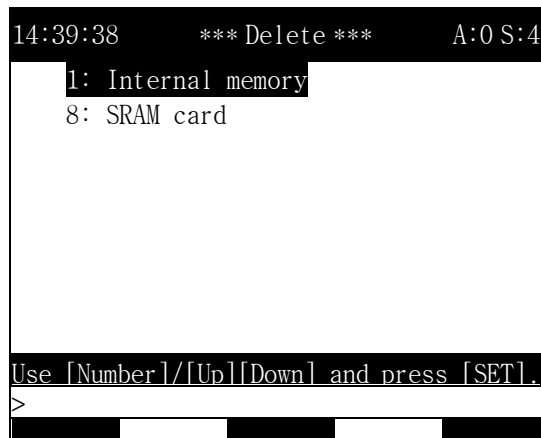
■ Select internal memory or SRAM card and Press [SET] key. The following is displayed
   as selecting internal memory.

```
14:39:38    *** Delete(RAM) ***    A:0 S:4
H120    .991   31    2001-07-09 13:34__
H120    .992   31    2001-07-09 13:34__
H120    .993   31    2001-07-09 13:34__
ROBOT   .C00   78    2001-06-30 11:12__
ROBOT   .C01   67    2001-06-30 11:12__
ROBOT   .E01   93    2001-06-30 11:12__
ROBOT   .IM0   10    2001-06-30 11:12__
ROBOT   .S01   561   2001-06-30 11:12__
ROBOT   .TR0   101   2001-06-30 11:12__


 15 file, 31351 Block free.  Page[ 1/2]
>
 Select  Cancel  Previous  Next
```

■ Select file and press " Execute" [PF5]. Refer to the above method to select file.
   Example is when selecting program "991"and pressing "Execute"[PF5].

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```
14:39:38   *** Delete(RAM) ***   A:0 S:4
H120   *991   31   2001-07-09 13:34__
H120   .992   31   2001-07-09 13:34__
H120   .993   31   2001-07-09 13:34__
ROBOT  .C00   78   2001-06-30 11:12__
ROBOT  .C01   67   2001-06-30 11:12__
ROBOT  .E01   93   2001-06-30 11:12__
ROBOT  .IM0   10   2001-06-30 11:12__
ROBOT  .S01  561   2001-06-30 11:12__
ROBOT  .TR0  101   2001-06-30 11:12__


H120   .991 : Delete? [Yes(All=1)/No]
>
 Select  Cancel  Previous  Next
```

■ The selected file is deleted as pressing (YES) key or cancelled by pressing (NO)key.

■ Press [1] key to delete all selected file, the following is displayed as pressing
  number [1] key.

```
Delete all the selected files? [YES/NO]
>
 Select  Cancel  Previous  Next
```

■ All selected file is deleted as pressing (YES) key or cancelled as pressing (NO)
  key.

3.5.7 Protect

Outline

Important program can be protected from modification or deletion. Files can be protected from any modification or deletion in full protection setting, only position can be editable in partial protection. playback staring from 0 step or step forward action is protected in playback protection.

Notation

_ _	: No protection	W_	: Full protect
WP	: Full protect + Playback	S_	: Partial protect
SP	: Partial protect + Playback	_ P	: Playback protect

Screen display

```
14:39:38      *** Protect ***       A:0 S:4
      1: Internal memory
      8: SRAM card




Use [Number]/[Up][Down] and press [SET].
>
```
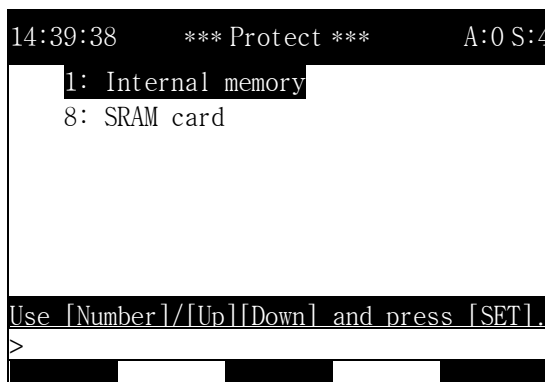
Operation Method

■ Select either internal memory or SRAM Card and Press [SET] key. The following is the
   window as selecting internal memory.

```
14:39:38  *** Protect(RAM) ***   A:0 S:4
H120    .991   31   2001-07-09 13:34__
H120    .992   31   2001-07-09 13:34__
H120    .993   31   2001-07-09 13:34__
ROBOT   .C00   78   2001-06-30 11:12__
ROBOT   .C01   67   2001-06-30 11:12__
ROBOT   .E01   93   2001-06-30 11:12__
ROBOT   .IM0   10   2001-06-30 11:12__
ROBOT   .S01  561   2001-06-30 11:12__
ROBOT   .TR0  101   2001-06-30 11:12__

 15file, 31351 Block free.   Page[ 1/ 2]
>
 Select  Cancel  Previous  Next
```
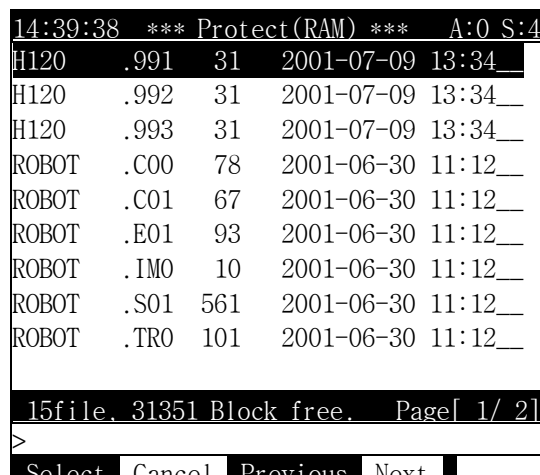
■ Select file and press "Execute"[PF5]. Refer to the above method to select file. The
  following example is when selecting program 991 and pressing "Execute"[PF5].

```
14:39:38  *** Protect(RAM) ***   A:0 S:4
H120    *991   31   2001-07-09 13:34__
H120    .992   31   2001-07-09 13:34__
H120    .993   31   2001-07-09 13:34__
ROBOT   .C00   78   2001-06-30 11:12__
ROBOT   .C01   67   2001-06-30 11:12__
ROBOT   .E01   93   2001-06-30 11:12__
ROBOT   .IM0   10   2001-06-30 11:12__
ROBOT   .S01  561   2001-06-30 11:12__
ROBOT   .TR0  101   2001-06-30 11:12__

 Protect or Release?(1:Protect/Release)
>
 Select  Cancel  Previous  Next
```

■ Select either protect or release and press [SET] key. The following message is
  displayed as selecting protect. Protect is protecting file and Release is releasing
  the protected file.

```
Protect type?(1:Whole/2:Section/3:Playb)
>1.
 Select  Cancel  Previous  Next
```

■ Select desired type of protection. The following message is displayed as selecting
  full protection.

```
14:39:38  *** Protect(RAM) ***   A:0 S:4
H120    .991    31 2001-07-09 13:34 W_
H120    .992    31 2001-07-09 13:34 __
H120    .993    31 2001-07-09 13:34 __
ROBOT   .C00   78   2001-06-30 11:12__
ROBOT   .C01   67   2001-06-30 11:12__
ROBOT   .E01   93   2001-06-30 11:12__
ROBOT   .IM0   10   2001-06-30 11:12__
ROBOT   .S01  561   2001-06-30 11:12__
ROBOT   .TR0  101   2001-06-30 11:12__

 15 file, 31351 Block free.  Page[ 1/ 2]
>
 Select  Cancel  Previous  Next
```

Reference

⑴ Constant file is in full protection mode even though partial protection is set.

⑵ File that is not program file can not set for playback protect.

⑶ Partial protection is identical to full protection when file is not the program file.

⑷ Each history files is upgraded even though full protection is set

⑸ Program can be executed from step 1 because playback protect checks step 0.

⑹ Full protect(W) and Partial Protect(S) can not be assigned together. Playback protect(P) can be assigned with either full protect(W) or partial protect(S) together.

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3.5.8 Storage Media Format

Outline

All the data in external storage device (SRAM Card Etc) can be deleted and DOS file
system is activated.

Screen display

```
14:39:38 * Storage Media Format *A:0 S:4
    8: SRAM card




Use [Number]/[Up][Down] and pree [SET].
>
```
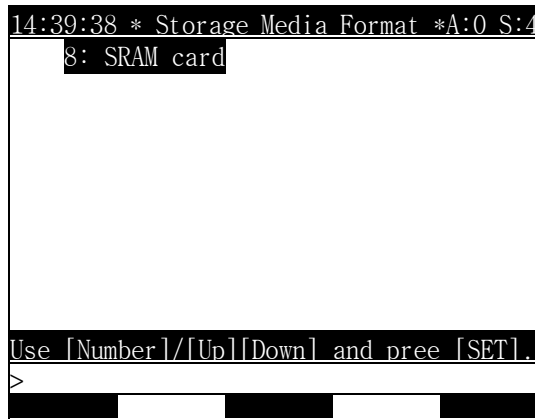
Operation method

 The following is displayed as selecting 8: SRAM Card and Pressing [SET] key.

```
14:39:38  ** SRAM Card Format ** A:0 S:4
 Select the number for the size of the
 SRAM card format

 [ 0]  Unit : Byte

 (1) 128K           (3) 512K

 (4) 1M    (5) 2M    (6) 4M


 Press execute[PF5] or [ESC] key
>[1 - 6]
```
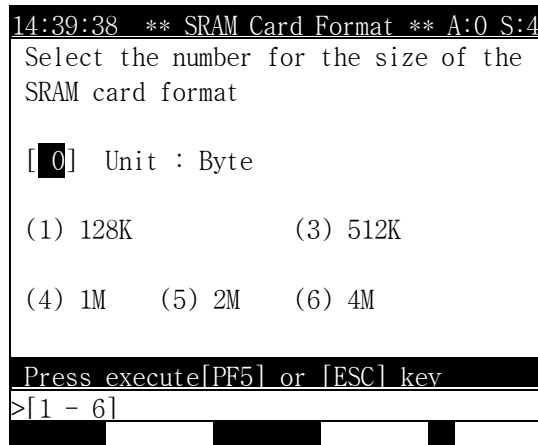
■ Format is executed as selecting storage capacity of SRAM card in the current board
  and pressing "Execute" [PF5]

3.5.9 Save/Load (SRAM Card)

Outline

System files and program files in memory of controller can be all saved or loaded to
SRAM card

Screen display

```
14:39:38* Save/Load all files * A:0 S:4
    1: Save all files to the SRAM card
    2: Load all files from the SRAM card




Use [Number]/[Up][Down] and press [SET].
>
```
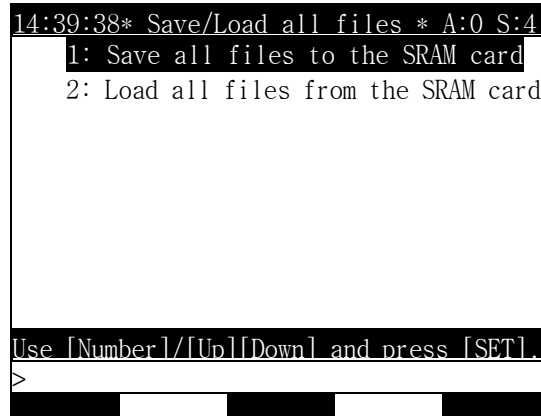
Operation method

1) All file Save (Memory -> SRAM)

   ■ The following is displayed as selecting 1: Save all files to the SRAM card.

```
1 folder, 2027 KB free.      Page [ 1/1]
>
Create          Previous  Next   Select
```

   ■ The following is displayed by pressing "Create[PF1]" in teaching pendant

```
14:39:38* Save/load all files * A:0 S:4
 .      [DIR]









"  '   *ABCDEFGHIJKLMNOPQRSTUVWXYZ
>
Delete    <-      ->    space
```

■ Enter the name of directory with arrow keys and press : "Complete" [PF5]. Cursor
  moves 5 section as pressing [Shift]key with arrow key.

2) All file Load (SRAM -> Memory)

■ The following is displayed as selecting 2: Load all files form the SRAM card.

```
.................................................
Enter the name if a folder to read.[Any]
>
███████      ███████       ███████
```
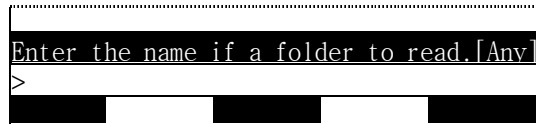
■ The following is displayed by pressing any key in teaching pendant

```
14:39:38* Save/load all files * A:0 S:4
 .        [DIR]
AAA       [DIR]      2001-07-09 10:30 __




 2 folder, 1999 KB free.     Page[ 1/ 1]
>
          Previous  Next    Select
```
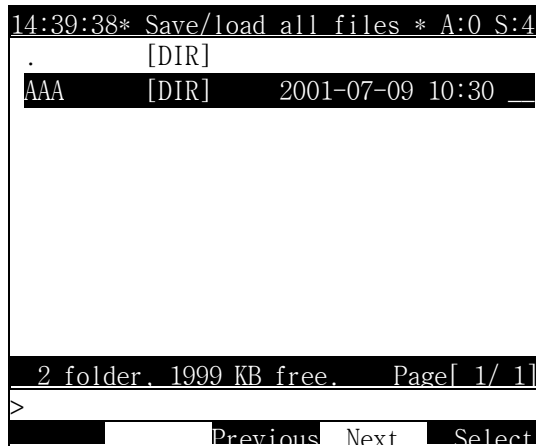
■ Enter the name of directory with arrow keys and press : "Select" [PF5].
  Cursor moves 5 section as pressing [Shift] key with arrow key.

Reference

⑴ File can not be loaded or saved individually from the directory created from All
   Save/Load (SRAM card)

⑵ Overwrite is not possible for the existing directory.

⑶ Notebook or PC card reader/writer device is needed in order to delete or rename
   directory created within SRAM card

3.6 Program Conversion

Outline

Program transformation is creating new program out of current existing program.

Screen display

```
14:39:38   *** Conversion ***    A:0 S:4
 1: Coordinate transfer
 2: Mirror Image
 3: Off-Line XYZ shift




Use [Number]/[Up][Down] and press [SET].
>
           Previous  Next
```

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3.6.1 Coordinate transformation

Outline

After teaching the program, in case of moving a target a workpiece in case of having many same workpiece, it is possible to use new workpiece to convert original program.

Example
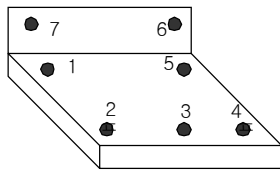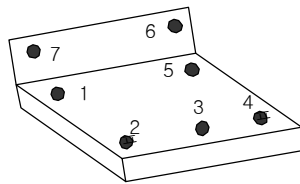
< Figure 1 >   < Figure 2 >

After teaching the program<Program 1> in the position of figure 1, it makes the program without teaching the entire steps in order to work the same workpiece of the position of figure 2.

It is possible to convert another program after setting the reference step to teach the step 1 to 3 of the converting program and (Program B) and the step 1 to 3 of original program (Program A)
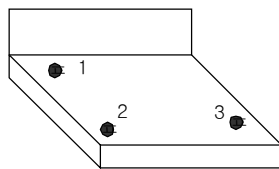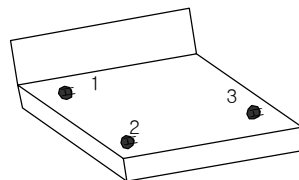
<Program A >   < Program B>
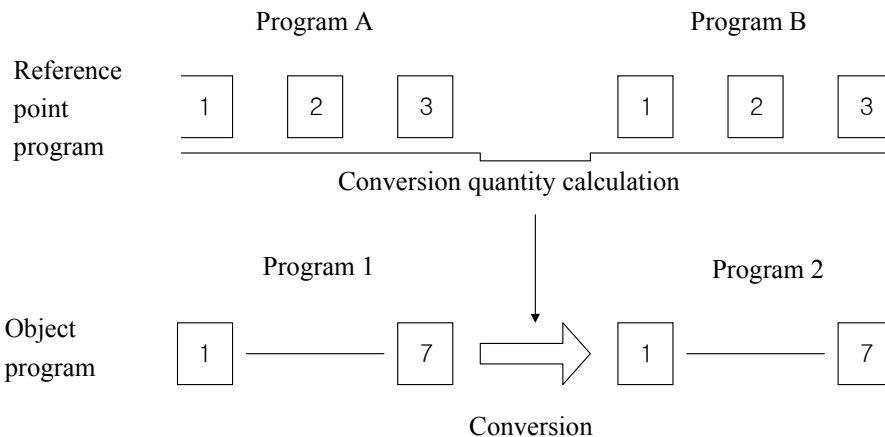
It calculates the transfer data from the 3 reference step of Program A and B..

Screen display

```
14:39:38  *** Coord Transf ***  A:0 S:4
 Reference point program
   Source 3 points program = [  0]
   Destin 3 points program = [999]
 Object program
   Source program        = [  0]
   Destination program    = [999]

 (In case of language-type program, only
   HIDDEN-POSE steps will be converted.)


Enter number and press [SET]
>[1 - 999]
```

Contents of window

■ Source 3 points program : Program number where the program has 3 steps that are
   reference steps and needed for coordinate conversion.(Example <Program A>)

■ Destin 3 points program : Program number where the program has 3 steps that are needed
   to define destination coordinate. (Example <Program B>)

■ Source program : Enter the number of program where the actual teaching job is
   recorded(Example <Program 1>)

■ Destination program : Enter the program number which converts program having teaching
   point.(Example <Program 2>)

Reference

⑴ The accurate teaching to the 3 reference point has great effect on the accuracy of the
   coordination transfer.

⑵ Please do not move on a large degree the posture of the wrist axis when you teach
    the 3 reference point.

⑶ The distance between the 3 reference point shall have a great distance way as
    far as possible.

3.6.2 Mirror Image

Outline

It makes the program with the position data that is the symmetry toward to the plane
passing through the line straight line being made by the S axis reference position of
the robot when a certain robot program is given. It makes a new program that is symmetry
to the position of wrist axis and the position of S-axis on the center of Y-Z plane
to the position of 0° axis of the robot.

Example

This function makes the best use in the work, request to the same movement for the two
robots in the right and left side. At this time, at first it teaches the work for the
one robot not the right side or left side, if it executes to transfer the program by
the mirror image.
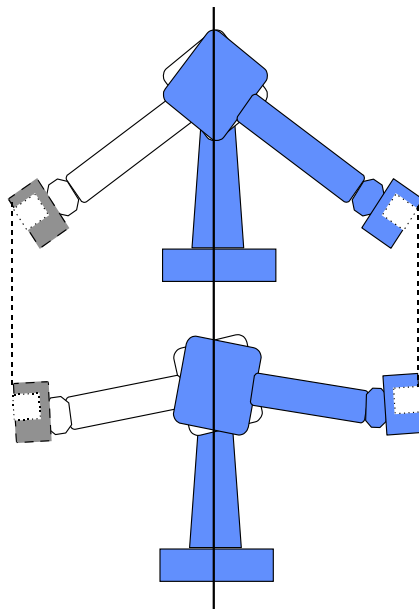
[Original Program → Mirror Image Transferred Program]

Screen display

```
14:39:38  *** Mirror Image ***   A:0 S:4
Source Program      = [  0]
Destination Program = [  0]
Additional axes
7Axis   = <DSBL,ENBL>




======== Limit over(step#) ==========

(In case of language-type program, only
  HIDDEN-POSE steps will be converted.)
Enter number and press [SET]
>[1 - 999]
```

Contents of window

■ Source Program : Enter the program number which has teaching points.

■ Destination Program : Enter the program number which convert the taught program as
   mirror image program

■ Additional Axes : Additional axes applicable to mirror image can be valid

Reference

(1) Displays overrange in soft limit that is checked in each step during conversion and
   displayed step number in over range step section.

```
14:39:38  *** Mirror Image ***   A:0 S:4
Source Program      = [999]
Destination Program = [999]
Additional axes
7Axis   = <DSBL,ENBL>

======== Limit over(step#) ==========
4, 7, 11, 16, 23, End

(In case of language-type program, only
  HIDDEN-POSE steps will be converted.)
Enter number and press [SET]
>[1 - 999]
                               Execute
```

At this time, "End" means that the step being out of the range of the soft limit isn't in the existence and larger => means that a greater number of step being out of the range of the soft limit is in the existence

⑵ After conversion, in case of having step out of soft limit, you must check which axis is out of soft limit.

⑶ The same type of robot must be used on right and left side for mirror image

⑷ The reference position of the encoder and 0 degree position of each axis set equally to the robot of the right side and left side.

⑸ Attach so that the same Gun with Hand or Gun with Hand being symmetry it may be symmetry to the right and left side or Gun with Hand being symmetry of the right and left side uses in each robot

⑹ The cable of Gun or Hand attach soft limit may be symmetry to the right and left side.

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3.6.3 Off-Line XYZ Shift

Outline

It shifts the step of the teaching completed within program and to make other program

Example
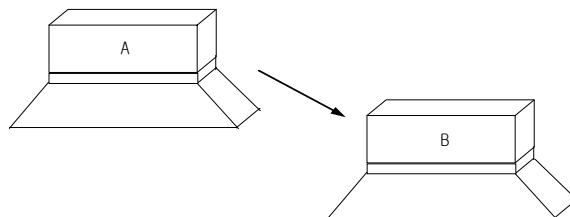
[Parallel transfer of the workpiece]

■ In case of moving the workpiece from the position A to the position B, Set the moving distance and execute " Off-Line XYZ shift", then program is transferred to program B
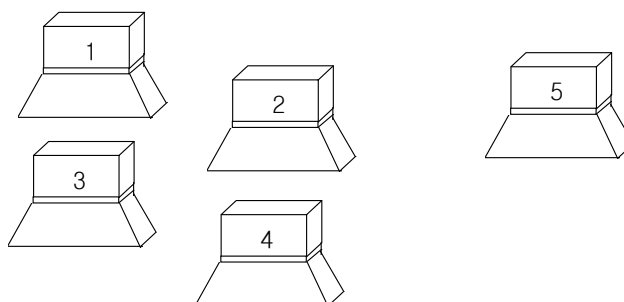
[Case where there are many workpiece with the same spec]

■ In case that there are several workpieces with the same spec, after teaching for the workpiece 1, for the workpiece 2 ~ 5, execute Off-line shift to the taught program.

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Screen display

```
14:39:38 * Off-Line XYZ Shift * A:0 S:4
Source            Destination
Program   = [999]   Program  = [999]
Start step = [  1]   End step  = [ 10]
Shift X=[   0.0] Y=[   0.0] Z=[   0.0]
Coordinate = < ROBOT, TOOL >
User coordinate NO. = [ 0]


(In case of language-type program, only
  HIDDEN-POSE steps will be converted.)

Enter number and press [SET]
>[1 - 999]
```

Contents of window

■ Source program : Enter the program number which has taught steps.

■ Destination program : Enter the program number which converts taught program through
   Off-Line XYZ Shift.

■ Start step : Enter the first step to start shift.

■ End step : Enter the last step to end shift.

■ Shift : Enter values of X, Y, Z direction.

■ Coordinate : Select either robot coordinate or tool coordinate as shift reference

■ User coordinate No. : Enter the User coordinate number if assigned.

3.7 System Checking

Following is displayed in system checking menu.

```
14:39:38 *** System checking *** A:0 S:4
1: System version              [R286]
2: Running time                [R 10]
3: Diagnosis of troubles
4: Error logging
5: Stop logging
6: History of operation


Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```

3.7.1 System version

Outline

 Displays software version of controller

Screen display

```
14:39:38 *** System version ***  A:0 S:4
Robot type: H120    (Axis: 6 Tot Ax: 6)
Main system Version => Robot Language
      Main S/W: V07.01-02  2001-06-18
    Motion S/W: V07.00     2001-07-09
     T/P Ver : V01.03      1999-05-31
     I/O Ver : V01.00      1997-04-09
DSP Version
     DSP1 S/W: V02.71      2000-03-20
     DSP2 S/W: V04.33      1993-03-29
     DSP3 S/W: V00.00         0-00-00
     DSP4 S/W: V00.00         0-00-00
_____

Control environment
     Conveyor synchronization = OFF
     Vibration control mode   = OFF




Press [ESC] or [R..]
>
              Previous  Next
```

3.7.2 Run time

Outline

It displays operating time of robot.

Screen display

```
14:39:38    *** Run time ***    A:0 S:4
         1: Display of run time
         2: Display of total run tiem
         3:      ( Clear all data    )
         4:      ( Clear run time     )
         5:      ( Clear cycle count )
         6:      ( Clear gun data     )
         7:      ( Clear I wait data )
         8:      ( Clear Timer wait data )


Use [Number]/[Up][Down] and press [SET].
>
             Previous  Next
```

3.7.2.1 Run time display

Screen display

```
14:39:38    *** Run time ***    A:0 S:4
*Run time =0:0: 0.00
Cycle time=0:0: 0.00        Cycle=0
GUN1 time =0:0: 0.00        count=0
GUN2 time =0:0: 0.00        count=0
GUN3 time =0:0: 0.00        count=0
GUN4 time =0:0: 0.00        count=0
DI Sig waiting time =0:0: 0.00
Timer waiting time  =0:0: 0.00


Press [ESC] or [R..]
>
```

Contents of window

(1) Run time : It displays the time till turning off after the start lamp turns
    on.
    (It resets automatically after 24 hours in turning it ON.)

(2) Cycle time : Number of the cycle played during the operation time. it is counted at the step 1. And through the robot is stopped during operation, counting is continued. (It is reset as exceeding 255 times)

(3) GUN ON Time : Gun signal output time per one cycle during operation. (After the lamp is on, it is reset after 24 hours)

(4) GUN ON count: Gun On signal output per 1 cycle in the operation. (After the lamp on, it is reset as exceeding 65535 times.)

3.7.2.2 Total Run time

Outline

Total amount of the operation time after power on. Total cycle time, total GUN ON time, and total Gun On count are as above, too.

Screen display

```
14:39:38    *** Run time ***    A:0 S:4
*Total run time   =0:0: 0.00
Total cycle count =0
GUN1 time =0:0: 0.00        count=0
GUN2 time =0:0: 0.00        count=0
GUN3 time =0:0: 0.00        count=0
GUN4 time =0:0: 0.00        count=0
DI Sig waiting time =0:0: 0.00
Timer waiting time  =0:0: 0.00


Press [ESC] or [R..]
>
```

3.7.2.3 Operation time reset

Outline

(1) Clear all data   ..... All data is cleared
(2) Clear run time   ..... Total work time is cleared.
(3) Clear cycle count   ..... Total cycle time is cleared
(4) Clear gun data   ..... Total GUN ON time and count are cleared.

Operation method

The following is displayed as selecting 3: Clear all data, 4: Clear run time, 5: Clear

cycle count, 6: Clear gun data, 7: Clear I wait data, 8: Clear Timer wait data.

```
Clear ( YES / NO )
>
```

■ Data is cleared as selecting (YES) and following is displayed.

```
14:39:38    *** Run time ***    A:0 S:4
*Total run time   =0:0: 0.00
Total cycle count =0
GUN1 time =0:0: 0.00       count=0
GUN2 time =0:0: 0.00       count=0
GUN3 time =0:0: 0.00       count=0
GUN4 time =0:0: 0.00       count=0
DI Sig waiting time =0:0: 0.00
Timer waiting time  =0:0: 0.00


Press [ESC] or [R..]
>
```

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3.7.3 Diagnosis of troubles

Outline

Displays the error diagnosis method of the robot.
When error occurs in the robot, it helps to main

Screen display

```
14:39:38  * Error code number *  A:0 S:4
E0110 Discharge resister overheated.
 Error code Number        [ 110]
Phenomena
      Check point: 1

 If you short-circuit TS1 and TS2 on
the Amp. any error occus?
(YES / NO)

Press [PF1],[PF2],[PF3] or [ESC]key!
>[1 - 1200]
    Yes      No     Return
```
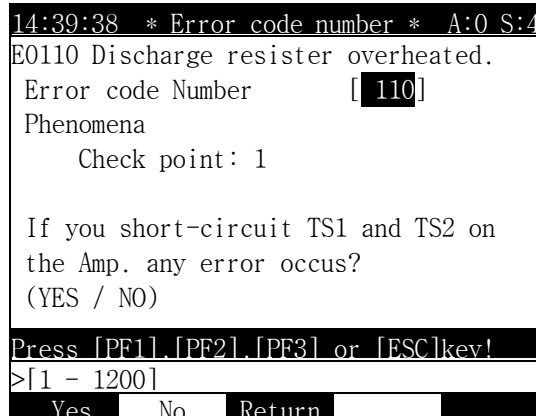
Operation method

■ In the diagnosis of the displayed error, select "YES"[PF1] key or "NO"[PF2]key for the
   question to the check point.

■ When you diagnosis the error with the exception of the displayed one, specify the error
   number and press [SET] key, and then "Execute" [PF5]key.

■ Or when your diagnose a trouble, select the item of the extraordinary using ↑, ↓ key
   and press [SET] key, then following is displayed.

```
14:39:38    *** Phenomenon ***   A:0 S:4
Phen1:Some axes do not move
Phen2:Malfunction of teaching pendant
Phen3:PLYBCK Pts mismatch recorded Pts
Phen4:Variation of playback point




Use [UP][Down]key and press [PF5]
>
                              Check!
```
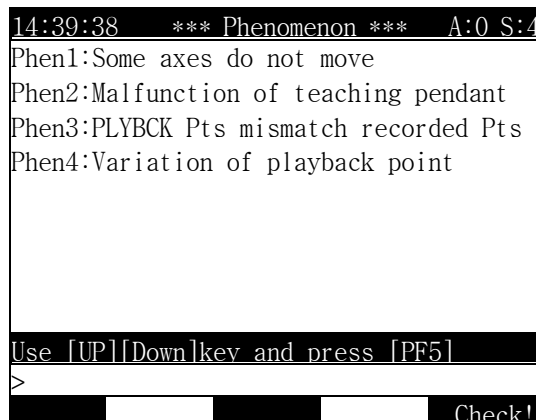
■ Use the arrow ↑, ↓ key to highlight the item about the state of the robot and press
   " Check!" [PF5] key. Then answer to the displayed check point item by "Yes"[PF1] key

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or "No"[PF2] key.

■ When you press " Yes" [PF1] or " No" [PF2]key by mistake, press " Return" [PF3]key to
return to the previous item.

3.7.4 Error logging

Outline

It displays the occurred error until now. It makes the restoration work, the occurring
cause of error judge correctly by referring to the history of error until now.

Screen display

```
14:39:38  *** Error logging ***  A:0 S:4
    1: W-0005  25 10:27
    2: E-0107  25 10:27
    3: E-0107  25 10:27
    4: E-0008  25 10:26
    5: E-0008  24 12:44
    6: E-0120  24 10:44
    7: E-0008  24 19:23
    8: E-0107  23 18:28
    9: E-0190  23 15:36
   10: E-0190  23 12:29
   11: E-0008  22 10:44

Use [Number]/[Up][Down] and press [SET].
>
Refresh?              Previous  Next
```
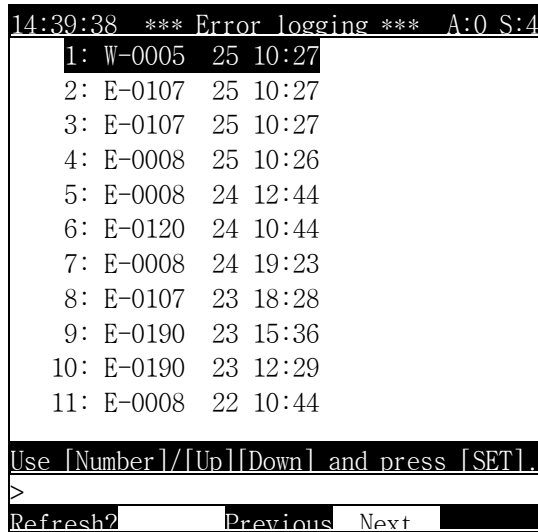
Operation Method

■ Following is displayed as selecting 1: W0005 25 10:27.
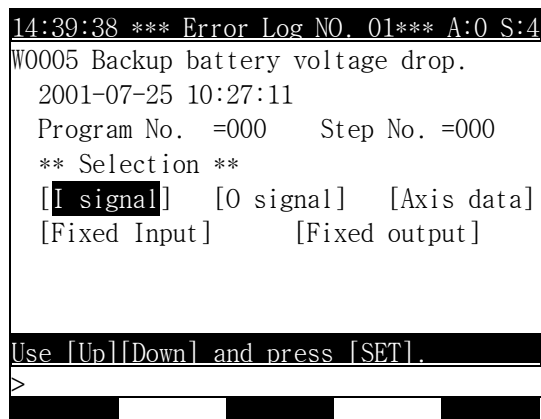
```
14:39:38 *** Error Log NO. 01*** A:0 S:4
W0005 Backup battery voltage drop.
  2001-07-25 10:27:11
  Program No. =000    Step No. =000
  ** Selection **
  [I signal]   [O signal]   [Axis data]
  [Fixed Input]        [Fixed output]



Use [Up][Down] and press [SET].
>
```

■ When you select either of followings, General Input/Output, Axis data, Fixed
Input/Output, state condition of each signals or data at the error occurrence.

_____

Reference
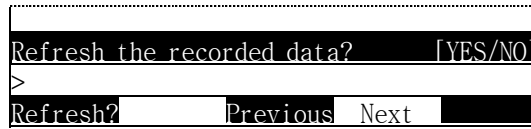
■ Following is displayed in guide frame as selecting " Refresh?" [PF1]key.

```
.................................
Refresh the recorded data?       [YES/NO]
>
Refresh?           Previous   Next
```

■ If (Yes)Key is selected, error history up to current list is all cleared If (No)Key
  is selected, it is cancelled.

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3.7.5 Stop History

Outline

It displays the stop history of the robot until now. It helps to maintain the robot recording the status of input, output, axis data, step number, program no of input content, stop time, a point of stop time in case of inputting the operating motor-off or stop command while operating

Screen display

```
14:39:38   *** Stop Logging ***   A:0 S:4
  1: F-01      25     10:36
  2: F-02      25     09:44
  3: F-03      24     13:54
  4: F-03      24     12:27
  5: F-03      24     10:44
  6: F-03      22     18:53
  7: F-03      22     17:36
  8: F-03      22     15:48
  9: F-03      22     15:27
 10: F-03      21     14:10
 11: F-03      21     09:44
Use [Number]/[Up][Down] and press [SET].
>
Refresh?             Previous  Next
```

Operation method

■ Following is displayed as selecting 1: F-01 25 10:36.

```
14:39:38 *** Stop Log  NO.01 *** A:0 S:4
 Internal stop have been inputted.
  2001-07-25 10:36:11
  Program No. =999    Step No. =010
  ** Selection **
  [I signal]  [O signal]  [Axis data]
  [Fixed Input]      [Fixed output]



Use [Up][Down] and press [SET].
>
```

■ When you select either of followings, General Input/Output, Axis data, Fixed

Input/Output, state condition of each signals or data at the stop occurrence.

Reference

■ Following is displayed in guide frame as selecting " Refresh?" [PF1] key.

```
┌───────────────────────────────────────┐
│ ......................................... │
│ Refresh the recorded data?    [YES/NO]  │
│ >                                       │
│ Refresh?        Previous  Next          │
└───────────────────────────────────────┘
```

■ If (Yes) Key is selected, error history up to current list is all cleared If (No)Key
   is selected, it is cancelled.

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3.7.6 Operation History

Outline

It displays an operation history until now. Stop command during operation or input in case of operation ready off, time of stop, program number, step number, axis data and input/output state at the stop are recorded to help maintenance of robot.

Screen display

```
14:39:38  ** Operation Hist **    A:0 S:4
   1.[SET]            2.[ESC]
   3.[PF3]            4.[PF4]
   5.[SET]            6.[DOWN]
   7.[DOWN]           8.[DOWN]
   9.[SET]           10.[ESC]
  11.[PF3]           12.[PF4]
  13.[SET]           14.[DOWN]
  15.[DOWN]          16.[DOWN]
  17.[SET]           18.[ESC]
  19.[PF3]           20.[PF4]
  21.[SET]           22.[DOWN]
Press [PF3], [PF4], [ESC] or [R..]
>
Refresh?          Previous  Next
```
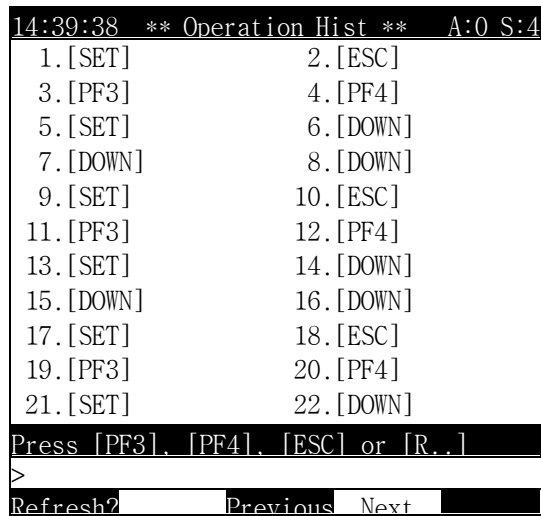
Contents of window

 (1) The names of keys operated on the teaching pendant
 (2) The keys on OP Panel) is as follow
 · Emergency stop
 · Motor-ON/Off
 · Start
 · Stop
 (3) Auto/Manual Switch
 (4) Safety plug

Reference

■ Following is displayed in guide frame as selecting " Refresh" [PF1] key.
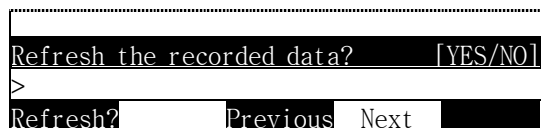
```
Refresh the recorded data?        [YES/NO]
>
Refresh?          Previous  Next
```

■ If (Yes) Key is selected, error history up to current list is all cleared. If (No) Key is selected, it is cancelled.

3.8 Date setting (Date, Time)

Outline

Date setting (Date, Time) can change date/time of controller.

```
14:39:38 *** Date/Time set *** A:0 S:4

   Date = 2001-07-25
   Time =   10:30:02




Select and Enter number, Press [SET]
>[1980-2079]
```

Operation method

■ Use arrow key to move the cursor on items, and enter the value and press [SET] key to insert
   input value.

■ Modified data is stored as pressing "Complete"[PF5] key, Cancels as pressing [ESC] Key.

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Chap 4 Condition Setting

Contents

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Chapter 4 Condition Setting

Press "Cond Set"[PF5] key in either playback mode or manual mode.

Screen display

```
14:39:38  *** Condition set ***  A:0 S:4
 1: Cycle type =<1Step,1Cycle,Continu>
 2: Step go/back max.speed(mm/s) = [200]
 3: Func in step GO/BACK  =<Off,On,I On>
 4: Speed rate=[100] GunStep=<DSBL,ENBL>
 5: Robot lock            =<DSBL,ENBL>
          Servo gun unlock<DSBL,ENBL>
 6: Rec speed type=<Standard,[%],[mm/s]>
 7: Interpolation base=  <R-tool,S-tool>
 8: Select user coordinate      =[ 0]


Press [SHIFT]+[<-][->] Key.
>
AppliCnd                          End
```


Modification method

Locate highlight bar on the item. Enter the values in input frame when value is needed to be entered. After entering numeric data keys, press [SET] for completion.

In case of selecting one of items in < >, press [SHIFT]+[→][←] to move highlight bar and for execution.

Reference

1) Condition setting is stored in (ROBOT.C00).
2) (ROBOT.C00) file can be modified even though it is in full protection.

4.1 Cycle type

Outline

Decide method of playback for the program.

① 1Step : 1step is executed while pressing start button. (Execution of step is
completed and robot stops as releasing the start button.)

② 1Cycle : Program is executed in one cycle and stop after pressing start button(Robot
stops when program reaches to the End command.)

③ Continue : Program is continuously executed. (Robot stop if external stop is
activated)

Reference

Following is displayed in accordance with setting for operation cycle.

```
14:39:38    *** Playback ***      A:0 S:4
T0                          SR:100% 1Cycl
PN:100[*]__ S/F:4/0    Sp:100.00
        Robot:H120, 6axes,  10steps
S1    MOVE P,S=100%,A=0,T=1
S2    MOVE P,S=100%,A=0,T=1
S3    MOVE P,S=100%,A=0,T=1
S4    MOVE P,S=100%,A=0,T=1
S5    MOVE P,S=100%,A=0,T=1
S6    MOVE P,S=100%,A=0,T=1
S7    MOVE P,S=100%,A=0,T=1



>
Service          Rel WAIT       Cond Set
```

All condition is displayed as
"1Step" "1Cycl" "Conti".

4.2 Step go/back max. speed

Outline

In manual mode, regardless of speed set in the program, speed of robot is operated between
1~250mm/s at step go/back.

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4.3 Function in step go/back

Outline

Decide activation of function at step go/back in manual mode.

① Off : Ignores other function except END function

② On : Execute all functions stored in step

③ I On : Execute Input delay function and END function only.

Reference

(1) At Step Back, Wait (I On) is only executed.

4.4 Speed rate

Outline

During the playback, speed recorded in step can be varied in setting rate within [1~100]% of robot movement speed

■ Gun Step

① Disable : Speed variation can not be applied for the step of GUN 1 or GUN2.

② Enable : Speed variation can be applied for the step of GUN 1 or GUN2.

4.5 Robot lock

Outline

Program is only executed without robot movement. By doing this peripherals and states
of In/output and software limit can be checked

" R123 in R code is the same function of Robot Lock.

① Disable : Robot Lock function is disabled.

② Enable : Robot Lock function is enabled.

Reference

 Robot Lock is set as <Enable>, the following is displayed in Manual or Auto mode.

```
14:39:38  *** M A N U A L ***    A:0 S:4
T0                   R-L
PN:100[*]__ S/F:4/0     Sp:100.00
     Robot:H120, 6axes, 17steps
S1   MOVE P,S=100%,A=0,T=1



Select PF menu
>
Service  System Rel.WAIT        Cond Set
```

Robot Lock is enabled

4.6 Record speed type

Outline

 Unit of speed for the step to be recorded is set according to Interpolation condition.
 R71 in R code "record speed setting method selection" is identical to the Record
 function.

① Standard ----   Interpolation OFF   : Percentage setting[%]
                  Linear Interpolation   : Speed setting[mm/sec]
                  Circular Interpolation   : Speed setting[mm/sec]

② [%]   ----   Interpolation ON/OFF : Percentage setting[%]

③ [mm/s]   ----   Interpolation ON/OFF : Speed[mm/sec]

4.7 Interpolation base

Outline

Recording step, Interpolation reference change Interpolation selected automatically. General interpolation method is robot base interpolation so that default value of controller is calculated with respect to robot base.
In order to record interpolation step of fixture, fixture is set as interpolation reference

Reference

In order to record step with fixture interpolation reference, Coordinate system of fixture is set. Refer to "System" [PF2] → 2. Controller parameter → 12. Coordinate setting → 2: Stationary tool coordinate.

4.8 User Coordinate

Outline

In manual operation, select coordinate system in order to activate linear coordinate system. In Manual mode, with jog operation of robot, it is utilized to operate linear coordinate with respect to User coordinate system
The robot executes to act the interpolation coordination system in direction of X,Y, and Z axis of the set coordinate system. When you use the monitoring function in the service of Manual or playback mode, X,Y and Z coordinate system of the front head of the tool being output on the screen

Reference

■ In Manual mode, when Number of User coordinate is selected, the following is displayed.

```
14:39:38 *** M A N U A L ***    A:0 S:4
T0                                      Crd:01
PN:100[*]__  S/F:4/0    Sp:100.00
        Robot:H120, 6축,  10 steps
S1    MOVE P,S=100%,A=0,T=1
S2    MOVE P,S=100%,A=0,T=1
S3    MOVE P,S=100%,A=0,T=1
S4    MOVE P,S=100%,A=0,T=1
      END


>
Service  System Rel.WAIT          Cond Set
```

Displaying selected User coordinate number

■ "0" is set as number of the user coordinate, it release the action for the user coordinate system and then executes to monitor and act the interpolation coordinate system for the robot coordinate system

■ Linear coordinate and monitoring to robot coordinate can be executed even though user coordinate is not defined or registered,

■ Registering User coordinate, refer to " System" [PF2] → 2. Controller parameter → 12. Coordinate setting → 1. User coordinate.

Chapter 5

Application condition

Contents

Chapter 5 Application condition

In " Cond Set" [PF5], Press " AppliCnd" [PF1].

Screen display

```
14:39:38* Application Condition  A:0 S:4
 1: Conveyor Oper=<Normal,Simulat.,Test>
 2: Search range              =[0.0]
 3: Search reference Pt. record=<Off,On>
 4: Spot welding    =<Wd-On,Sq-On,SqOff>
 5: Gun search Ref.point record=<Off,On>
 6: Output(DO) signal clear =<DSBL,ENBL>
 7: Shift register clear    =<DSBL,ENBL>


Press [SHIFT]+[<-][->] Key
>
                                 Cond Set
```
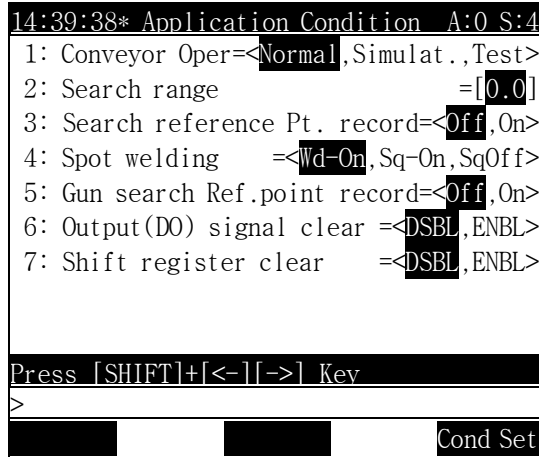
Operation method

Move the highlight bar on the item. For inserting numeric data, enter the numbers in
input frame. After entering the number, press[SET] key to apply.

In order to select item within < >, press [SHIFT]+[→][←] to move the highlight bar
for selection.

※Press either [Esc] or "Cond Set"[PF5], "Condition setting Manu" is displayed.

 Reference

1) Application condition data is stored in control constant file (ROBOT.C00).
2) It can be changed event though control constant file (ROBOT.C00) is in full protection.

5.1 Conveyor operation

Outline

It determines the movement of robot when robot handles workpiece on conveyor,
① Normal : Robot moves synchronously according to actual movement of workpiece on
             conveyor.

② Simulation : Without operating conveyor, user can operated robot movement by
               entering conveyor speed. It is useful to check cycle time after teaching.

③ Test : Like plat test, it is the condition where conveyor is not operated and robot
          movement can be checked. Different aspects from plan test is that teaching
          point can be checked at stop condition of workpiece as pulse count is not
          reset even though executing Program END

Reference

■ Depending on setting condition for conveyor movement, the following is displayed
   in manual or auto mode.

```
14:39:38      *** A U T O ***      A:0 S:4
T0                 C-N        SR:100% 1Cycl
PN:100[*]__ S/F:4/0
       Robot:H120, 6axes,  10 steps
S1   MOVE P,S=100%,A=0,T=1
S2   MOVE P,S=100%,A=0,T=1
S3   MOVE P,S=100%,A=0,T=1
S4   MOVE P,S=100%,A=0,T=1
S5   MOVE P,S=100%,A=0,T=1
S6   MOVE P,S=100%,A=0,T=1
S7   MOVE P,S=100%,A=0,T=1
S8   END


>
Service          Rel_WAIT         Cond_Set
```

According to the Mode,"C-N","C-S"," C-T" are displayed.

■ Conveyor pulse count not to related move type is only counted by activation of limit
   switch.

■ In simulation, value calculated from distant is not always correct because pulse
   counter of conveyor is separated from registry

■ Normally, in playback mode, conveyor speed has actual movement speed of conveyor,
   but, in plan test operation, plan test speed entered from user is always 0 value.

5.2 Search Range

Outline

Define the range to be searched when you use search function.
X value can be set between 0.0~3.0 and the range is as follows.

```
    Teaching Point              Teaching Point
        | ←           L          → |
        ● -------------------●------------- |
        | ←        Search Range = L(1+X)        → |
```
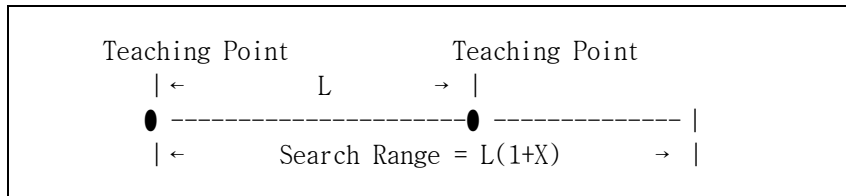
5.3 Search reference position record

Outline

Search reference data is automatically recorded with reference position value of
workpiece after 1 cycle playback, as setting search function ON upon the condition that
workpiece is placed after the completion of teaching including search function.

① Off : Disable search reference position data record function.

② On : Enable search reference position data record function.

Reference

■ The following is displayed in manual or auto mode as setting search reference position
  data record "On"

```
14:39:38    *** A U T O ***    A:0 S:4
TO SW                      SR:100% 1Cycl
PN:100[*]__ S/F:4/0
        Robot:H120, 6axes, 10 steps
S1    MOVE P,S=100%,A=0,T=1
S2    MOVE P,S=100%,A=0,T=1
S3    MOVE P,S=100% A=0 T=1
>
Service         Rel WAIT         Cond Set
```

State of search reference
position record.

■ 1 cycle playback shall have the same speed of normal playback at recording search
  reference position data.

5.4 Spot welding

Outline

In servo gun application and activating spot welding function, regardless setting of defined welding sequence, pressurization and current signal output can be disabled. This function is useful for teaching position check and spot point check when no actual welding is performed and peripherals are not equipped.

① Wd-On : Execute all welding sequence defined in spot welding function.

② Sq-On : It activates pressurization movement and current signal is not output in order to check pressurization point because welding signal is delayed.

③ SqOff : Pressurization and current signal output and welding complete delay are not activated.

Reference

The following is displayed in manual or auto mode according to the condition of spot welding output method

```
14:39:38     *** A U T O ***      A:0 S:4
T0 G1        Wd-On          SR:100% 1Cycl
PN:100[*]__ S/F:4/0              W:01S:01
          Robot:H120, 6 axes,  10 steps
S1    MOVE P,S=100%,A=0,T=1
S2    MOVE P,S=100%,A=0,T=1
S3    MOVE P,S=100%,A=0,T=1
S4    MOVE P,S=100%,A=0,T=1
S5    MOVE P,S=100%,A=0,T=1
S6    MOVE P,S=100%,A=0,T=1
S7    MOVE P,S=100%,A=0,T=1
S8    END


>
Service          Rel WAIT        Cond Set
```

According to the output type, "Wd-On","Sq-On","SqOff"are displayed.

■ In playback with SqOff, robot skips to the next step without activating pressurization at welding point.

■ In order to implement welding after checking teaching position, Wd-ON must be set.

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5.5 Gun Search reference point record

Outline

In case of using servo gun or equalizer, reference position shall be recorded to reduce wear of electrode.
Refer to Servo gun manual or robot equalizer manual for Gun search operation

① Off : Disable function of Gun search reference position record

② On : Enable function of Gun search reference position record

Reference

■ The following is displayed in Manual or Auto mode, as setting On for Gun search reference position record

```
14:39:38    *** A U T O ***        A:0 S:4
TO G1 SW  "d-On                   SR:100% 1Cycl
PN:100[*]__ S/F:4/0                 W:01S:01
         Robot:H120, 6 axes, 10 steps
S1    MOVE P,S=100%,A=0,T=1
S2    MOVE P,S=100%,A=0,T=1
S3    MOVE P,S=100%,A=0,T=1
S4    MOVE P,S=100%,A=0,T=1
S5    MOVE P,S=100%,A=0,T=1
S6    MOVE P,S=100%,A=0,T=1
S7    MOVE P,S=100%,A=0,T=1
S8    END

>
Service            Rel WAIT          Cond Set
```

State of (Gun) search reference position record.

■ After installation of system, replace electrode with new and operate one cycle before teaching job.

■ "System"[PF2] → 3. Machine parameter → 5. Setting encoder offset 2. Encoder calibration (Data input) must be set and 1 cycle of playback has to be performed to record Gun Search reference point

■ Without recording Gun search reference point, error will occur if spot welding or Gun Search is executed,

5.6 Output(DO) signal clear

Outline

In executing step 0, initialization for current general I/O and welding signal has to be set.

① Disable : Does not initialize output signal (DO) at the execution step 0.

② Enable : Does initialize output signal (DO) at the execution step 0..

5.7 On-line Shift Register Clear

Outline

Setting to initialize shift register of online shift registry group In executing step0.

① Disable : Does not initialize contents of shift register at the execution step 0
② Enable : Does initialize contents of shift register at the execution step 0.

Reference

This function is only used to decide for initialization in contents of online shift register group and does always initialize the contents of XYZ shift register or online shift buffer.

Chapter 6 System setting

Contents

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Chapter 6 System setting

The following is displayed as selecting " System" [PF2] of initial menu in Manual mode.

```
14:39:38 *** System setting ***  A:0 S:4
1: User parameter
2: Controller parameter
3: Machine parameter
4: Application parameter
5: System format
6: Automatic constant setting


Use [Number]/[Up][Down] and press [SET]
>
                      Previous  Next
```
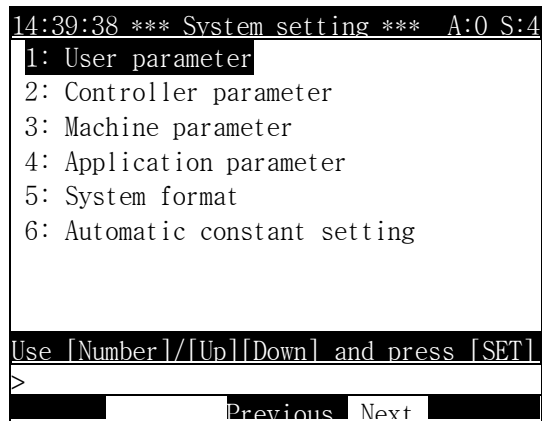
Selection method

① Use the arrow keys to move the highlight bar to the item to be selected and press[SET]key to enter the next menu

② Use the numeric keys to insert item number to be selected and Press [SET]key to enter sub menu.

6.1 User configuration

The following condition can be set in the window below as selecting user parameter.

```
14:39:38  * User configuration * A:0 S:4
 1:Display language(언어)=<한글,English>
 2:Default Pose     =<Base,Robot,Encoder>
 3:Robot Start type=<In,Ex,Remote Start>
 4:Cursor Change on AutoMode=<DSBL,ENBL>
 5:Confirm Delete Command   =<DSBL,ENBL>
 6:WAIT(DI/WI) releas        =<DSBL,ENBL>
 7:Separation of T/P         =<DSBL,ENBL>
 8:Power failure detection   =<DSBL,ENBL>
 9:External program select   =<DSBL,ENBL>
10:Step strobe signal use    =<DSBL,ENBL>
11:Step set alarm type       =<ONE ,TWO >
----------------------------------------
12:Cursor Max. Line ratio    = [ 80]%
13:Collision sensor
  (1)Sensor            =<Emegency,Stop>
  (2)Signal logic      =<Posi,Negative>


Press [SHIFT]+[<-][->] Key.
>
          Previous Next    End
```

Modification method

Place highlight bar on the item. In case of inserting numeric data, insert numeric data
in the input frame. After inputting numeric keys and press [SET] key for execution.
In case of selecting item within < >, press [ENABLE]+[→][←] to move highlight bar
to the item for completion.

Reference

■ User system data is stored in control constant file (ROBOT.C00).

■ Modification or change is not allowed when control constant file (ROBOT.C00) is in
   full protection. Except, 6.1.1 (Display language) can be changed and initialized
   when main power is switched to "On".

6.1.1 Display language

Outline

 Select current language at current display on Teaching pendant

① 한글 : Displays Korean language on Teaching pendant.

② English : Displays English Language on Teaching pendant.

Reference

■ Type of language is automatically selected according to Dip Switch no1. of BD411
  board when main power is switched to" ON"

■ Dip Switch No 1 of BD411 : On → English, Off → Korean.

6.1.2 Pose Record Type

Outline

Position of robot is recorded as hidden pose when robot is recorded by pressing REC
key after movement. It will decide record type of current step position

① Base : Current step position is recorded in the reference of base coordinate system

② Robot : Current step position is recorded in the reference of robot coordinate system

③ Encoder : Current step position is recorded as encoder value

Reference

■ Record the position of robot as hidden pose and press key to check or modify
  the record type of step.

6.1.3 Start type

Outline

 Define starting method of robot system. Same as pressing " R5: external start selection (Enable/Disable) of R code

① Internal : Press start button in OP panel to start the robot

② External : Start the robot by receiving external digital signal . Refer to chapter
        12 Signal Connection → 1. External start of Standard Input signal.

③ Remote : Start the robot by receiving command from Central control unit. This is
        not supported in Hi4 controller

Reference

■ Operator is in the range of robot working range or within safety fence, in case of
  setting external or remote start for start type, robot might automatically move
  certainly even though stop lamp in control cabinet is displayed because external
  or remote start signal can be activated at any time. For safety, start type of robot
  shall be set as internal start.

6.1.4 Change of cursor position in Auto mode

Outline

 Decide cursor to be moved for step or function with Enable or Disable setting in Auto
mode. For safety, manufacturer recommend disable setting.

① Disable : Disable cursor movement for Step or Function in Auto mode

② Enable : Enable cursor movement for Step or Function in Auto mode

Reference

■ As setting cursor position change <Disable>, the following message is displayed when
  up/down cursor key is pressed in Auto Mode.

```
.............................................
Inhibit cursor step change on AUTO MODE
>
Service         Rel.WAIT          Cond Set
```

6.1.5 Confirm when the command delete

Outline

This function enables you to use this function by setting "Enable" or "Disable" when you want to confirm whether it is acceptable for you to delete some command or not before deleting the command.

① Disable : If you select this function, It does not ask to you whether it is good or not to delete before you delete the function or step by pressing the [SHIFT]+[DELETE] Key.

② Enable : If you select this function, It asks to you whether it is good or not to delete before you delete the function or step by pressing the [SHIFT]+[DELETE] Key.

Reference

■ It is displayed the following massage on the screen when you delete the function or step by pressing the [SHIFT]+[DELETE] Key.

```
Delete(Yes/No)?
>
Service  System Rel.WAIT       Cond Set
```
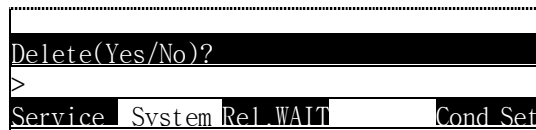
■ Delete when press [Yes] key, Cancel when press [No] key.

6.1.6 WAIT (DI/WI) Forcible Release

Outline

You can set up whether you will release forcibly the signal wait or not when press the "WAIT RELEASE" for waiting the welding completion signal or input signal in the manual mode or auto mode.

① Disable : It doesn't release forcibly the wait signal when pressing "WAIT RELEASE" for waiting the welding completion signal or input signal .

② Enable : It release forcibly the wait signal when pressing "WAIT RELEASE" for waiting the welding completion signal or input signal

6.1.7 Dettachment of Teach Pendant

Outline

It playbacks the teaching program after dettaching the teach pendent to protect the program. But, only after completing the teaching.

① Disable : It occurs the communication error if you dettach the teach pendent to the controller in case of setting the "Disable".

② Enable : You can operate the robot even though you dettach the teach pendent in case of setting the "Enable".

6.1.8 Power failure Detection (Not Changeable)

Outline

If you select this function, After The robot restores the present position in the Memory in the time of the Power failure occurrence, You can playback the robot from the position which is restored in the memory when the Power failure supply.

① Disable : If you select this function, you can't use this power failure detection.

② Enable : In this case, you can use this function.

Reference

■ Because in the present controller Power failure detection sets <Enable>, you can't change <Disable>.

6.1.9 External Program selection

Outline

It decides the method that select the program you made. It is the same to the "R6 External Program Selection (Enable/Disable) of R6.

① Disable : You can select the program by pressing the [SHIFT]+[Program]Key.
② Enable : It selects the program after receiving the digital signal from the external device. Chapter 12. the connection of each signal → 1. Please refer to the program selection signal of standard input signal.

Reference

■ It is displayed on the screen of Teach pendent in auto mode as following according to compounding "System" [PF2] → 1. User Parameter → 3. START TYPE and 9. External Program Selection.

External Program Start Type	Disable	Enable
Internal	Auto	Auto(Ext.Prog)
External	Auto(Ext.Start)	Auto(Ext.P&S)

6.1.10 Using the program strobe signal

Outline

You can use this function when you want to select the external program by receiving the external digital signal from the external device..

① Disable : This function selects a program to be worked by receiving only program selection signal.

② Enable : This function selects a program to be worked by receiving the program selection signal in the moment of turning on input signal of program strobe.

 Reference

■ It displays the following massage on the screen in case of the inputting the external start signal without inputting the program selection signal in advance.

```
The value of Prog Selec Sig input is 0
>
Service  System Rel.WAIT        Cond Set
```

■ Please refer to the chapter.12 Signal connection → 1. Program strobe of Standard input signal..

6.1.11 STEP SET ALARM TYPE

Outline

This is a function that can output the alarm signal (pulse 200msec) when you select
the step that is out of the present step.

① ONE : This alarm signal comes when you select the step that is different more than
2 step compared to the present step a output signal in manual mode or 1
step(auto mode).

② TWO :
 - This alarm signal outputs in case of designating the step that is a different step
   (more than 2step) compared to the present step in manual, auto (1step / 1cycle /
   continue) mode.
 - This alarm signal outputs in case of selecting different program when selecting
   bigger step than step 0 in the present program in manual, auto (1step / 1cycle /
   continue) mode.
 - This alarm signal outputs in case of designating the same program when selecting
   bigger step than step 2 in the present program in manual, auto (1step / 1cycle /
   continue) mode.

Reference

■ This alarm signal outputs as the assigned signal in " SYSTEM" [PF2] → 2. CONTROL
   PARAMETER → 1. SETTING THE INPUT/OUTPUT SIGNAL → 6: OUTPUT SIGNAL ASSIGNMENT.

6.1.12 Lowest position proportion of the cursor

Outline

You can adjust the cursor position from the upper part to the lower part of the screen
by adjusting the position proportion of the cursor in the edit screen of manual mode.

You can't see the next function, step of the lowest part of the screen because the cursor
moves to the lowest part of the screen in case that you adjust the position proportion
to maximum 100%.

The cursor can move within the range from the upper to the center if the proportion
is 50%, the screen scroll if the cursor move from the center to the lower.

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6.1.13 Using the collision sensor

Outline

It selects one of the method that can stop the robot if the collision sensor active..

(1) Robot stop type

① Emergency stop : It stops the robot with MOTOR OFF.

② Stop : It stops the robot in the MOTOR ON status.

(2) Signal Logic

① Positive : It sets up input signal logic of collision sensor with positive.

② Negative : It sets up input signal logic of collision sensor with positive.

6.2 Controller Parameter

It displays the following massage on the screen if you select "SYSTEM[PF5] → 2.Controller Parameter" in the first screen of manual mode

```
14:39:38** Controller parameter**A:0 S:4
  1: Setting input & output signal
  2: Serial ports
  3: Robot ready
  4: Registration of home position
  5: Return to the previous position
  6: End relay timer
  7: Interlock timer
  8: Error-output to the outside
  9: Power saving : PWM OFF
 10: Shift limit
 11: f-key setting
---------------------------------------
 12: Coordinate setting




Use [Number]/[Up][Down] and press [SET].
>
           Previous  Next
```

Selection Method

① You can enter into the sub-menu if press [SET]Key after moving the highlights bar
   with using the arrow key to the item as you want to select.

② You can enter into the sub-menu if press [SET]Key after the item number as you want
   to select input with using the number key in the input frame.

Reference

■ The control parameter store in the control constant file (ROBOT.COO).
■ You can't change the contents of the control constant file (ROBOT.COO) in case of
   being in perfectly protective status.

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6.2.1 Input/Output signal selection

Outline

It sets up when you need to change the attribution of the input/output signal.

Screen display
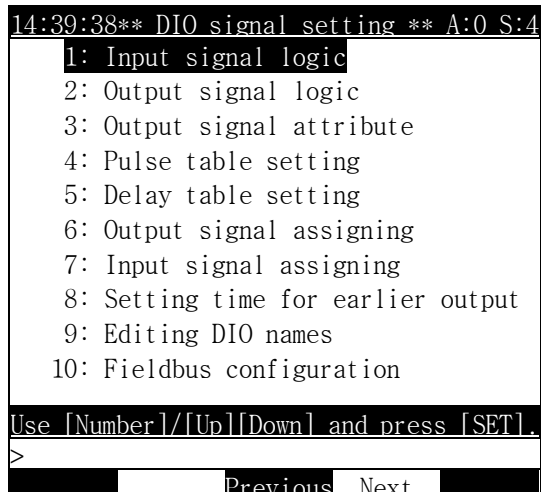
```
14:39:38** DIO signal setting ** A:0 S:4
     1: Input signal logic
     2: Output signal logic
     3: Output signal attribute
     4: Pulse table setting
     5: Delay table setting
     6: Output signal assigning
     7: Input signal assigning
     8: Setting time for earlier output
     9: Editing DIO names
    10: Fieldbus configuration

Use [Number]/[Up][Down] and press [SET].
>
            Previous  Next
```

Selection Method

① You can enter into the sub-menu if press [SET]Key after moving the highlights bar
   with using the arrow key to the item as you want to select.

② You can enter into the sub-menu if press [SET]Key after the item number as you want
   to select input with using the number key in the input frame.

6.2.1.1 Input signal logic

Outline

It sets up the positive, negative of the general input signal.

Screen display

```
14:39:38*** DI signal logic *** A:0 S:4
 DI1  = <Posi,Nega>  DI2  = <Posi,Nega>
 DI3  = <Posi,Nega>  DI4  = <Posi,Nega>
 DI5  = <Posi,Nega>  DI6  = <Posi,Nega>
 DI7  = <Posi,Nega>  DI8  = <Posi,Nega>
 DI9  = <Posi,Nega>  DI10 = <Posi,Nega>
 DI11 = <Posi,Nega>  DI12 = <Posi,Nega>
 DI13 = <Posi,Nega>  DI14 = <Posi,Nega>
 DI15 = <Posi,Nega>  DI16 = <Posi,Nega>
 DI17 = <Posi,Nega>  DI18 = <Posi,Nega>
 DI19 = <Posi,Nega>  DI20 = <Posi,Nega>
Press [SHIFT]+[<-][->] Key
>
                    Previous  Next
```

Selection Method

① The user move to the position that the user wants to change input signal logic. you can use the "Next [PF4]", "Previous [PF3] if there is no signal that you want to change in the present screen..

② It changes signal logic with using [Shift]+[←][→]Key.

Reference

■ You must press the "Complete"[PF5] to save the changed content after finishing to change the input signal logic, if press "Cancel" Key you can't save the changed content.

6.2.1.2 Output signal Logic

Outline

It sets up the positive, negative logic of the general output signal.

Screen display

```
14:39:38*** DO signal logic ***  A:0 S:4
  DO1  = <Posi,Nega>  DO2  = <Posi,Nega>
  DO3  = <Posi,Nega>  DO4  = <Posi,Nega>
  DO5  = <Posi,Nega>  DO6  = <Posi,Nega>
  DO7  = <Posi,Nega>  DO8  = <Posi,Nega>
  DO9  = <Posi,Nega>  DO10 = <Posi,Nega>
  DO11 = <Posi,Nega>  DO12 = <Posi,Nega>
  DO13 = <Posi,Nega>  DO14 = <Posi,Nega>
  DO15 = <Posi,Nega>  DO16 = <Posi,Nega>
  DO17 = <Posi,Nega>  DO18 = <Posi,Nega>
  DO19 = <Posi,Nega>  DO20 = <Posi,Nega>
Press [SHIFT]+[<-][->] Key
>
                    Previous  Next
```

Selection Method

① The user moves the cursor to the position where the user wants to change.
  You can use "Previous [PF3]", "Next [PF4]" if there is no signal as you want to change
  in the present screen.

② You change the signal logic with using [Shift]+[←][→]Key.

  Reference

  ■ You must always press the "Complete [PF5]"Key to store the changing content after
    finishing the change of output signal logic.

6.2.1.3 The attribution of Output signal

Outline

It decides the attribution of output signal. If the number of output signal is normal "0", the number 1 to 15 output the pulse signal to be assigned in the pulse signal table, and the number 16 to 30 output the delay signal assigned in the delay signal table.

Screen display

```
14:39:38 ** DO Sig attribute **  A:0 S:4
 DO1   = [ 0]        DO2   = [ 0]
 DO3   = [ 0]        DO4   = [ 0]
 DO5   = [ 0]        DO6   = [ 0]
 DO7   = [ 0]        DO8   = [ 0]
 DO9   = [ 0]        DO10  = [ 0]
 DO11  = [ 0]        DO12  = [ 0]
 DO13  = [ 0]        DO14  = [ 0]
 DO15  = [ 0]        DO16  = [ 0]
 DO17  = [ 0]        DO18  = [ 0]
 DO19  = [ 0]        DO20  = [ 0]
 DO21  = [ 0]        DO22  = [ 0]
Select and Enter number. Press [SET]
[Normal[0]; Pulse[1-15]; Delay[16-30]]
                    Previous  Next
```

Selection Method

① The user moves the cursor to the position where the user wants to change the attribution of the output signal. You can use "Previous [PF3]", "Next [PF4]" if there is no signal as you want to change in the present screen.

② You press the [SET]Key after inputting the number in the input frame with using the number key.

Reference

■ You must press the "Complete"[PF5] to save the changed content after finishing to change the input signal logic, if press "Cancel" Key you can't save the changed content.

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6.2.1.4 Setting the Pulse table

Outline

3: It sets the content about the pulse signal of pulse number that input in the attribution of the output signal.

Screen display

```
14:39:38   *** Pulse table ***   A:0 S:4
 Table    Count   ON time       OFF time
   1  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   2  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   3  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   4  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   5  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   6  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   7  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   8  =  [ 0]    [ 0.00]sec    [ 0.00]sec
   9  =  [ 0]    [ 0.00]sec    [ 0.00]sec
  10  =  [ 0]    [ 0.00]sec    [ 0.00]sec
 Select and Enter number. Press [SET]
 >[1 - 100]
              Previous  Next
```

Selection Method

① The user moves the cursor to the position where the user wants to change the attribution of the output signal. You can use "Previous [PF3]", "Next [PF4]" if there is no signal as you want to change in the present screen.
② You press the [SET]Key after inputting the number about the On/Off time, frequency with using the number key in the input frame.

Reference

■ For example of outputting the pulse)

```
        Frequency: 3,    ON time: 1second,    OFF time: 0.3 second
           1second   0.3second
          ←           → ← →
         +---------+  +---------+  +---------+
      ---+           +--+          +--+          +--
```

■ You must press the "END"[PF5] to save the changed content after finishing to change the output signal attribution, if press "CANCEL" Key you can't save the changed content.

6.2.1.5 Setting the delay table

Outline

3: It sets the content about the delay signal of delay number that input in the
attribution of the output signal.

Screen display

```
14:39:38   *** Delay table ***   A:0 S:4
 Table   Count   ON delay    OFF delay
  16  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  17  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  18  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  19  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  20  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  21  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  22  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  23  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  24  =  [ 0]   [ 0.00]sec  [ 0.00]sec
  25  =  [ 0]   [ 0.00]sec  [ 0.00]sec
Select and Enter number. Press [SET]
>[0 - 99.99]
                      Previous  Next
```

Selection Method

① The user moves the cursor to the position where the user wants to change the
attribution. You can use "Previous [PF3]", "Next [PF4]" if there is no signal as
you want to change in the present screen.

② You press the [SET]Key after inputting the number about the On/Off delay with using
the number key in the input frame.

Reference

■ For example of the delay output）
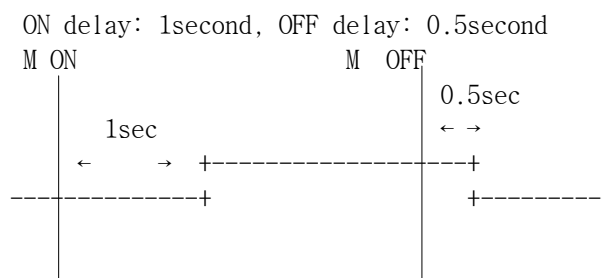
```
            ON delay: 1second, OFF delay: 0.5second
            M ON                      M  OFF
                                          0.5sec
                                          ← →
                 1sec
              ←      →  +----------------+---+
            ---+----------+                    +----------
```

■ You must press the "Complete"[PF5] to save the changed content after finishing
to change the output signal attribution, if press "Cancel" Key you can't save
the changed content.

6.2.1.6 Output signal Assignment

Outline

It uses the signal after output signal assign in special DO signal.

Screen display

```
14:39:38 ** DO Sig assignment ** A:0 S:4
GUN (squeeze) Sig = G1 [ 23]   G2 [ 24]
MX(Unfolding) Sig = X1 [ 25]   X2 [  0]
Alarm to welding system     =   [  0]
Weld stick warning          =   [  0]
Program end                 =   [ 26]
Synthetic error             =   [ 27]
Emegency stop               =   [  0]
Manual mode                 =   [  0]
Collision sense             =   [  0]
Step set warning            =   [  0]
 Interlock-abnormal warning  =   [ 28]
Select and Enter number. Press [SET]
>[1 - 256]
All FormOne FormPrevious  Next  Complete
```

Reference

(1) All Initialize: It initializes all of assigned output signal. It displays the
    following massage on the screen if you select All initialize function.

```
All Init.?Hardwiring:0,Fieldbus:1(0 - 1)
>[0 - 1]
All FormOne FormPrevious  Next  Complete
```

■ If you select the standard number "0", All of assigned signal changes the initializing
   value.

■ If you select the field bus(1), It redeploys output assignment signal to use the
   field bus. if you select the field bus(1), it displays the following massage.

```
Input the start port number.(1 - 32)
>[1 - 32]
All FormOne FormPrevious  Next  Complete
```

Input the start port number to be assigned. if the start port number select "1",
it displays the following massage.

```
14:39:38 ** DO Sig assignment **  A:0 S:4
GUN (squeeze) Sig = G1 [  1]   G2 [  2]
MX(Unfolding) Sig = X1 [  3]   X2 [  0]
Alarm to welding system    =  [  0]
Weld stick warning         =  [  0]
Program end                =  [  7]
Synthetic error            =  [  8]
Emegency stop              =  [  0]
Manual mode                =  [  0]
Collision sense            =  [  0]
Step set warning           =  [  0]
Interlock-abnormal warning =  [ 13]
Select and Enter number. Press [SET]
>[1 - 256]
All Form One Form Previous  Next  Complete
```

⑵ One initialize: Presently selected output assignment signal value return to the initialize status.

⑶ Assigned DO signal displays the small character in the "Service"[PF1] → 1. MONITORING.

  ex) In case of not assigning : O31

   In case of assigning : o31

⑷ If press " Complete" [PF5], Save changed information. if press [Cancel]Key, Cancel them.

6.2.1.7 Input signal assignment

 Outline

 It uses the signal after output signal assign in special DI signal.

 Screen display

```
14:39:38 ** DI Sig assignment ** A:0 S:4
External start             =   [ 23]
External stop              =   [ 24]
Prog selection bit= B01[ 25]  B02[ 26]
                    B03[ 27]  B04[ 28]
                    B05[ 29]  B06[ 30]
                    B07[ 31]  B08[ 32]
Program Strobe             =   [  0]
Binary/Discrete(OFF->Binary) =  [  0]
External reset             =   [  0]
Low speed command          =   [  0]
WI              = W1 [ 22]  W2 [  0]
Select and Enter number. Press [SET]
>[1-256]
All Form One Form Previous  Next  Complete
```

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Reference

(1) All Initialize: It initializes all of output assignment signal. It displays the
   following massage on the screen if you select All initialize function.

```
All Init.?Hardwiring:0,Fieldbus:1(0 - 1)
>[0 - 1]
All FormOne FormPrevious  Next   Complete
```

■ If you select the standard number "0", all of assigned signal changes the initializing
   value.

■ If you select the fieldbus(1), It redeploys input assignment signal to use the
   field bus. if you select the field bus(1), it displays the following massage.

```
Input the start port number.(1 - 30)
>[1 - 30]
All FormOne FormPrevious  Next   Complete
```

Input the start port number to be assigned. if the start port number select "1",
it displays the following massage.

```
14:39:38 ** DI Sig assignment ** A:0 S:4
External start              =    [  1]
External stop              =    [  2]
Prog selection bit= B01[  3]  B02[  4]
                    B03[  5]  B04[  6]
                    B05[  7]  B06[  8]
                    B07[  9]  B08[ 10]
Program Strobe             =    [  0]
Binary/Discrete(OFF->Binary) =  [  0]
External reset             =    [  0]
Low speed command          =    [  0]
WI            = W1 [ 15]  W2 [  0]
Select and Enter number. Press [SET]
>[1-256]
All FormOne FormPrevious  Next   Complete
```

(2) One initialize: Presently selected output assignment signal value return to the
   initialize status.

(3) Assigned DO signal displays the small character in the "Service"[PF1] → 1.
   MONITORING.
   ex) In case of not assigning : O31
       In case of assigning   : o31

(4) If press " Complete" [PF5], Save changed information. if press [Cancel]Key, Cancel
   them.

6.2.1.8 Setting the Earlier output

Outline

Usually, the DO signal output after getting to the step, You can use this function
when you output DO signal before getting to the step by setting this function.

Screen display

```
14:39:38 *** Earlier output ***  A:0 S:4
Sig      Time       Low DO     High DO
DO    = [ 0.00]sec   [   0]      [   0]


                     Low GO     High GO
0-bype= [ 0.00]sec     [   0]       [   0]




Select and Enter number. Press [SET]
>[1 - 99.9]
```

Screen description

■ Earlier out time : It sets the first out time of group output signal(GO) or each
output signal before getting to the step.

■ DO lower number : This is a first number of each output signal(DO) that is going to
do first out.
■ DO upper number : This is a last number of each output signal(DO) that is going
to do first out.
■ GO lower number : This is a first number of each output signal(GO) that is going
to do first out.
■ GO upper number : This is a last number of each output signal(GO) that is going
to do first out.
 Reference

 ■ But, This first out function can't apply when the step go and back in manual
mode.
 ■ If you press " Complete" [PF5] key, save the changed information. If press [CANCEL]
key , Cancel them.

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6.2.1.9 DIO Name Edit

Outline

The user names in each in/out signal.

Screen display

```
14:39:38    ***   DIO name   ***   A:0 S:4
  1: Page 1
  2: Page 2
  3: Page 3
  4: Page 4




Use [Number]/[Up][Down] and press [SET].
>
                    Previous  Next
```

Operation Method

■ You press [SET] after selecting the page as you want with the cursor or number key.
   if selecting page 1, the following massage is displayed.

```
14:39:38       *** Page 1 ***       A:0 S:4
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
  <DI,DO>   [  0]   [                    ]
Press [SHIFT]+[<-][->] Key.
>
```

Screen description

■ < ,DO> : You can select input/output signal as you want to describe with using
           [Enable][->][<-]key.

■ [0] : Input the number of in/output signal as you want to describe. Press the
          [SET]key after inputting the number with the number key in input frame.

■ [   ] : Resister the name of in/output signal.

Reference

⑴ The following massage is displayed if the highlight bar move to the position in the
[   ] part.

```
Press [SET] for string input
>
```

■ The following massage that can input the character string is displayed if [SET] input.

```
14:39:38  ** Character input **  A:0 S:4
DIO name

1234567890 ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
?!.,@#$%^&"+-*/<=>;:(){}[]'|~`
ㄱㄲㄴㄷㄸㄹㅁㅂㅃㅅㅆㅇㅈㅉㅊㅋㅌㅍㅎ
ㅏㅐㅑㅒㅓㅔㅕㅖㅗㅘㅙㅚㅛㅜㅝㅞㅟㅠㅡㅢㅣ
ㄱㄲㄳㄴㄵㄶㄷㄸㄹㄺㄻㄼㄽㄾㄿㅀㅁㅂㅄㅅㅆ
ㅇㅈㅊㅋㅌㅍㅎ



Use [Up][Down], and press [SET]
>
                                  Complete
```

■ You can input the name of DIO if press [PF5]key after making the character with using
the arrow key and [SET]key in the input frame.

⑵ You can make the new file (ROBOT.IMO : DIO FILE) if press "Complete"[PF5]key after
inputting in the name description.

⑶ You can see about the recorded DIO name in " SERVICE" [PF1] → 1. MONITORING OF DIO
NAME.

⑷ If you press " Complete" [PF5]key, Save the changed information. If press [CANCEL]
key , Cancel them.

6.2.1.10 Setting the field bus

Outline

It sets the Fieldbus parameter.

Screen display

```
14:39:38 ** Fieldbus Config **  A:0 S:4
1: En/Disable Fieldbus Adapter
2: Select Input Source
3: Assign Input No
4: Assign Output No




Use [Number]/[Up][Down] and press [SET]
>
         Previous  Next
```
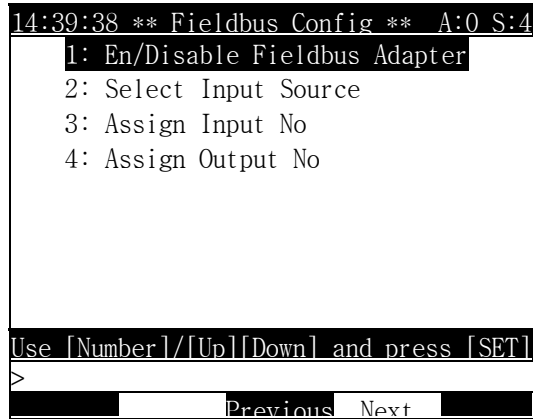
Selecting Method

① You can enter into the sub-menu if press [SET] Key after moving the highlights bar with using the arrow key to the item as you want to select.

② You can enter into the sub-menu if press [SET] Key after the item number as you want to select input with using the number key in the input frame.

Reference

■ If you set up the field bus for the first time after formatting the controller, the following massage is displayed when you select one of 4 menu.

```
File not exist. Create file?  [YES]/[NO]
>
                              Done
```

■ You enter into the setting work with producing the ROBOT.FBU file to store the field bus parameter if press [YES] key.

6.2.1.10.1 Application of the field bus adapter

Outline

It select whether Fieldbus will use or not.

Screen display

```
14:39:38* En/Disable Fieldbus * A:0 S:4
 Fieldbus Adapter            =<Off,On>




    
    

[SHIFT]+[<-][->] to En/Disable
>
                                    Done
```
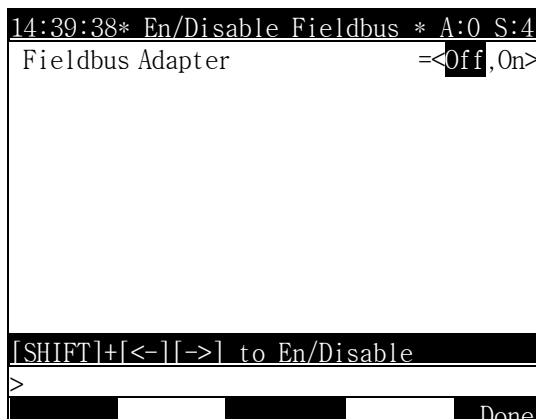
Screen description

① Off : Can not use the field bus.

② On : Can use the field bus.

Reference

■ If you press " Done" [PF5] key, save the changed information. If press [CANCEL]
  key , Cancel them.

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6.2.1.10.2 Input source selection

   Outline

   It sets up from which of the hard wired or field bus the input receives.

   Screen display

```
14:39:38 * Select Input Source *A:0 S:4
 Select Input Source
 0    DI1  -   DI8   <-  <HWrd,Fbus>
 1    DI9  -  DI16   <-  <HWrd,Fbus>
 2   DI17  -  DI24   <-  <HWrd,Fbus>
 3   DI25  -  DI32   <-  <HWrd,Fbus>
 4   DI33  -  DI40   <-  <HWrd,Fbus>
 5   DI41  -  DI48   <-  <HWrd,Fbus>
 6   DI49  -  DI56   <-  <HWrd,Fbus>
 7   DI57  -  DI64   <-  <HWrd,Fbus>

               Page 1/4
[SHIFT]+[<-][->] to select input src
>
All FormPg FormPrevious  Next      Done
```

   Reference

```
All Init.?Hardwiring:0,Fieldbus:1(0 - 1)
>[0 - 1]
All FormPg FormPrevious  Next      Done
```

(1) All initialize : All of input source selection modify standard or Fbus at one time.
            The following massage is displayed if " All Form" [PF1] select.

■ All of input source of the screen change <STANDARD> if press [SET]key after
  standard[0] input.

■ All of input source of the screen change <Fbus> if press [SET]key after field bus
  [1] input.

(2) Page initial : The page that describes on the present screen change the standard
            or Fbus. The following massage is displayed if you select "Pg
            Form" [PF2].

```
Pg Form .?Hardwiring:0,Fieldbus:1(0 - 1)
>[0 - 1]
All FormPg FormPrevious  Next      Done
```

■ If press [SET]key after the standard [0] input the input source of the screen that
    is displayed in the present teach pendent change <STANDARD>.

■ If press [SET]key after the field bus [1] input the input source of the screen that
    is displayed in the present teach pendent change <Fbus>.

⑶ The present setting item will save if press " Done" [PF5], it will not save if press
    [CANCEL].

6.2.1.10.3 Input signal assignment

    Outline

    It sets each signal group unit how you will map each input.

    Screen display

```
14:39:38  *** Assign Input No *** A:0 S:4
Assign Input No to Fbus Data
 0   DI1 -  DI8  <-  [ 0]  Fbus_0
 1   DI9 -  DI16 <-  [ 1]  Fbus_1
 2  DI17 -  DI24 <-  [ 2]  Fbus_2
 3  DI25 -  DI32 <-  [ 3]  Fbus_3
 4  DI33 -  DI40 <-  [ 4]  Fbus_4
 5  DI41 -  DI48 <-  [ 5]  Fbus_5
 6  DI49 -  DI56 <-  [ 6]  Fbus_6


              Page 1/4
Set Fbus element No to map to input
>[0 - 31]
All Form      Previous  Next    Done
```

■ Please press the [SET] after inputting the Fbus data that should use the input to
    be mapped as the input signal.

    Reference

■ The first data of Fbus data is redeployed if press "ALL Form" [PF1].

■ If you press " Done" [PF5] key, Save the changed information. if press [CANCEL] key , Cancel
them.

6.2.1.10.4 Output signal assignment

Outline

It sets each signal group unit how you will map each output.

Screen display

```
14:39:38*** Assign Outpur No *** A:0 S:4
Assign Output No to Fbus Data
 0    01 -   08  ->  [ 0]   Fbus_0
 1   011 -  018  ->  [ 1]   Fbus_1
 2   021 -  028  ->  [ 2]   Fbus_2
 3   031 -  038  ->  [ 3]   Fbus_3
 4   041 -  048  ->  [ 4]   Fbus_4
 5   051 -  058  ->  [ 5]   Fbus_5
 6   061 -  068  ->  [ 6]   Fbus_6


            Page  1/4
Set Fbus element No to map to output
>[0 - 31]
All Form        Previous   Next    Done
```

■ Please press [SET]key after inputting Fbus data that should use the output to be
  mapped in the standard output signal.

   Reference

■ The first data of Fbus data is redeployed if press "ALL Form"[PF1.].

■ If you press " Done" [PF5] key, Save the changed information. If press [CANCEL] key , Cancel
  them.

   Caution

(1) Do always in the off status in case of not building in BD470. If you put in the On
    status without building in BD470, All of the I/O function don't work with occurring
    the error in the controller.

6.2.2 Serial port

Outline

It sets up the use purpose of the serial port, and sets up the RS232C parameter

```
14:39:38 *  Serial port select* A:0 S:4
1: Teach Pendant  (CNTP)
2: Serial to I/O Board (CNIO)
3: Serial port #1 (CNSIO)
4: Serial port #2 (OPSIO)




Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```

6.2.2.1 Teach Pendant (CNTP)

Outline

This port is only for teach pendent. The user can't change freely. The following massage is displayed on the screen if the user select 1: Teach Pendant (CNTP).

```
Can't modify! Private port for T/P.[ESE]
>
              Previous  Next
```

6.2.2.2 Private serial port for I/O board

Outline

This is only for I/O board. You should set up the parameter (Baud rate, character bit, stop bit, parity bit, echo) to match with the present I/O board.

Screen display

```
14:39:38 *** Serial to I/O ***  A:0 S:4
Baudrate = <...,9600,19200,38400,57600>
Character length = <7,8> bit
Stop Bit        = <1,2> bit
Parity bit      = <Disable,Odd,Even>
Echo            = <Disable,Enable>



Press [SHIFT]+[<-][->] Key
>

```

Reference

■ If you press " Complete" [PF5] key, Save the changed information. If press [CANCEL]
   key, Cancel them.

6.2.2.3 Serial port #1

Outline

This is a serial port (CNSIO), It sets up the communication information when you
communicate with a serial port. The user should select the purpose of the serial
port #1, echo, parity bit, stop bit, character bit, baud rate as you want.

Screen display

```
14:39:38 *** Serial port 1 ***  A:0 S:4
Baudrate = <38400,19200,9600,4800,2400>
Character length = <7,8> bit
Stop bit        = <1,2> bit
Parity bit      = <Disable,Odd,Even>
Echo            = <Disbale,Enable>
Serial port usage= <FileMng,Sens>


Press [SHIFT]+[<-][->] Key
>

```

Reference

■ FileMng ...... You can use this function to download and up load the file from the
   external computer and visa versa.

■ Sens ...... You can use this function to receive the shift value from the vision.
(Interface with the external vision system)

6.2.2.4 The use of the serial port #2

Outline

This is a serial port (OPSIO), It sets up the communication information when you communicate with a serial port. The user should select the purpose of the serial port #1, echo, parity bit, stop bit, character bit, baud rate as you want.

Screen display

```
14:39:38 *** Serial port 2 ***  A:0 S:4
Baudrate = <-,19200,38400,57600,115200>
Character length = <7,8> bit
Stop Bit        = <1,2> bit
Parity Bit      = <Disable,Odd,Even>
Echo            = <Disable,Enable>
Serial port usage= <FileMng,Sens>


Press [SHIFT]+[<-][->] Key
>

```

Reference

■ FileMng ...... You can use this function to download and up load the file from the external computer and visa versa.

■ Sens ...... You can use this function to receive the shift value from the vision.
(Interface with the external vision system)

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6.2.3 Robot Ready

Outline

The robot outputs robot ready end signal if the robot is ready.

The robot ready output signal is a DO signal to be assigned in the "SYSTEM" [PF2] →
2. Controller parameter → 1. IN/OUT SIGNAL SETTING → 6: OUTPUT SIGNAL ASSIGNMENT.

Screen display

```
14:39:38  *** Robot ready ***     A:0 S:4
Robot ready condition = [ 1]
0: Motor on + Auto Mode(1 cycle)
1: Motor on + Auto Mode(1 cycle)    >
   + External start + External program
2: Motor on
3: Motor on + Running
4: Motor on + Running + Interlock wait
5: Motor on + Auto Mode(1 Cycle/1 Step)
6: Motor on + Auto Mode(Continuous)
7: Motor on + Auto Mode

_____

Robot ready condition = [ 1]
8: Auto Mode(1Cycle) + External start >
   + External program
9: MotorOn + Runnig + AutoMode(contin)>
   + Internal start + External program
10: Motor on + Playback(Continuous)
   + Internal start + External program



Enter number and press [SET]
>[0 - 10]
                Previous  Next  Complete
```

Reference

(1) You can see the result in the "SERVICE" [PF1] → 1. MONITORING if the robot ready
    signal comes out.

(2) If you press "Complete" [PF5]key, Save the changed information. If press [CANCEL]
    key, Cancel them..

6.2.4 Home position registration

Outline

This signal outputs when a robot motion is in this home position after a specific
position of the robot register as a home position of this robot

The home position output signal is a DO signal to be assigned in the "SYSTEM"[PF2]
→ 2. CONTROL PARAMETER → 1. IN/OUT SIGNAL SETTING → 6: OUTPUT SIGNAL ASSIGNMENT.

Actual screen

```
14:39:38  *** Home position ***  A:0 S:4
Home 1 : Program No.  = [    0]
             Step No.  = [   1]

             Range                Range
S = [            1000]   H = [        1000]
V = [            1000]   R2= [        1000]
B = [            1000]   R1= [        1000]

Select and Enter number. Press [SET]
>[0 - 999]
```

Screen description
■ Program No. : This is the program no. recorded the robot motion to be registered
  as a home position.

■ Step No. : This is the step no. recorded the robot motion to be registered
  as a home position.

■ Range : This is the range to the motion of each axis of the robot in home position.

   Reference
   ⑴ If you press "Complete"[PF5]key, Save the changed information. if press [CANCEL]
      key , Cancel them.
   ⑵ The range set up as the value of encoder bit of each axis unit. The setting value
      use the range of the - direction and + direction of home position point. For example
      If you select 100Bit the output range of the home position signal is 200Bit.
   ⑶ Registration cancel automatically if delete step or program that is registered.

   ⑷ The registered step No. change automatically in case of adding and deleting the step
      between the previous and next of home position step in the program that registered
      as a home position.

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6.2.5 Return to the previous position

Outline

This is the function that the robot returns to the previous position automatically when turning the motor on because the robot may be dropped to the down by the weight of the robot when turning the motor off by the H/W error or emergency stop etc.

Screen display

```
14:39:38 ** Previous position ** A:0 S:4
Return to previous Posi  = <DSBL, ENBL>
Limit for return[mm]       = [  10]
Limit for error detect[mm] = [ 100]




Press [SHIFT]+[<-][->]
>
```

Screen description

■ Previous return function : It selects whether the previous return function will use or not.

■ Return range : It sets up the limit value that can return after dropping the robot The alarm massage is displayed when dropping over the setting value.

■ Error detection range : This is for anti interference of the peripheral equipment. The robot can't start without designating the step and occur the error when dropping over the setting value.

Reference

(1) If you press " Complete" [PF5]key, Save the changed information. If press [CANCEL] key , Cancel them.

6.2.6 End Relay Output Time

Outline

It sets up the time until the step 0 execute again after end the program by setting
the output time of this signal when the program execute in continuous auto mode.

Screen display

```
14:39:38   *** End relay ***   A:0 S:4
END relay ON time      = [ 0.0] sec




Enter number and press [SET]
>[0.0 - 10.0]
```
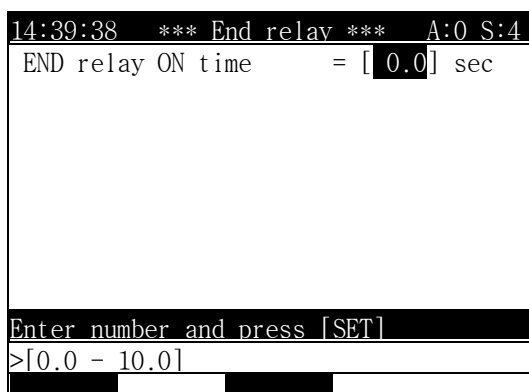
■ Press [SET] after input the end relay output time in input frame.

Reference

⑴ If you press " Complete" [PF5]key, Save the changed information. If press [CANCEL]
    key , Cancel them.

6.2.7 Interlock error time

Outline

It sets up the maximum waiting time of input signal.

Interlock error time output if the time of input waiting status during playback is over the reference time. This function that is to set up this reference time is a interlock error time.

This interlock error time is a O signal to be assigned in the " SYSTEM" [PF5] → 2. CONTROL PARAMETER → 1. IN/OUT SIGNAL SETTING → 6: OUTPUT SIGNAL ASSIGNMENT.

Screen display

```
14:39:38  *** Interlock Abn.***  A:0 S:4
 Interlock error timer  = [ 60] sec




Enter number and press [SET]
>[0 - 255]
```

■ Press [SET] after inputting the interlock error time in the input frame.

Reference

⑴ If you press " Complete" [PF5]key, Save the changed information. if press [CANCEL] key , Cancel them.

6.2.8 External error output

Outline

This is the function that outputs the detected error no. to the external device.

Screen display

```
14:39:38 *** Error output ***  A:0 S:4
 Serial output    =<Disable,Port1,Port2>
 Discrete output  = <Disable,8bit,16bit>




 Press [SHIFT]+[<-][->]
>
```

■ The serial output outputs ASCII code to the external device using serial interface(RS232C).

                    Output type are
                    First byte   : " $"
                     2nd~6th byte   : " ERROR"
                     7th byte   : " " (Blank)
                     8th~11th byte : error number
                     12th byte   : C_R
                     13th byte   : L_F

   For example

  In case of error 0101(E0101)

           $ E R R O R   0 1 0 1 C_R L_F
          └_┴_┴_┴_┴_┴_┴_┴_┴_┴_┴_┴_┴
           1 2 3 4 5 6 7   8 9 10 11 12 13

■ First number designation output outputs the error number to the external device through
   the O signal assigned in the " SYSTEM" [PF2] → 2. CONTROL PARAMETER → 1. IN/OUT
   SIGNAL SETTING → 6: OUTPUT SIGNAL ASSIGNMENT.

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Signal name	Assignment and Quantity	
	Type 1	Type 2
Error output select	O : 1EA	×
Error output STRB	O : 1EA	×
Error output Bit	O : 8EA	O : 16EA

① Type 1 (8bit output)

It outputs after dividing by 2 group. One is the upper 8 bit, The other is the lower 8 bit after the error number transfers the binary code. The signal classifying the upper data and lower data is the error output selection signal, The strobe signal deciding the data check timing is the error output STRB signal.

For example

the timing in case of occurring E0101
(101_{10} = 0065_{16} = 0000 0000 0110 0101₂)

```
               | ←   Lower data →    | ←  Upper data→ |
                 +-----------------+
      01  -+          1             +--------0-----------------
      
      02  ----------0-------------------------0-----------------
                 +-----------------+
      03  -+          1             +--------0-----------------
                      0                        0
      04  --------------------------------------------------
      
      05  ----------0-------------------------0-----------------
                 +--------1---------+          0
      06  -+                        +-------------------------
                 +--------1---------+          0
      07  -+                        +-------------------------
                      0                        0
      08  --------------------------------------------------
                 +-----------------+
The output selection -+          +-------------------------
                    +---------+            +---------+
The error selection STRB  -----+        +----------+          +-----------
               | ←  → | ←      → | ↔ | ← → | ←      → | ← → |
                 100ms   200ms   50ms 100ms   200ms   100ms
```
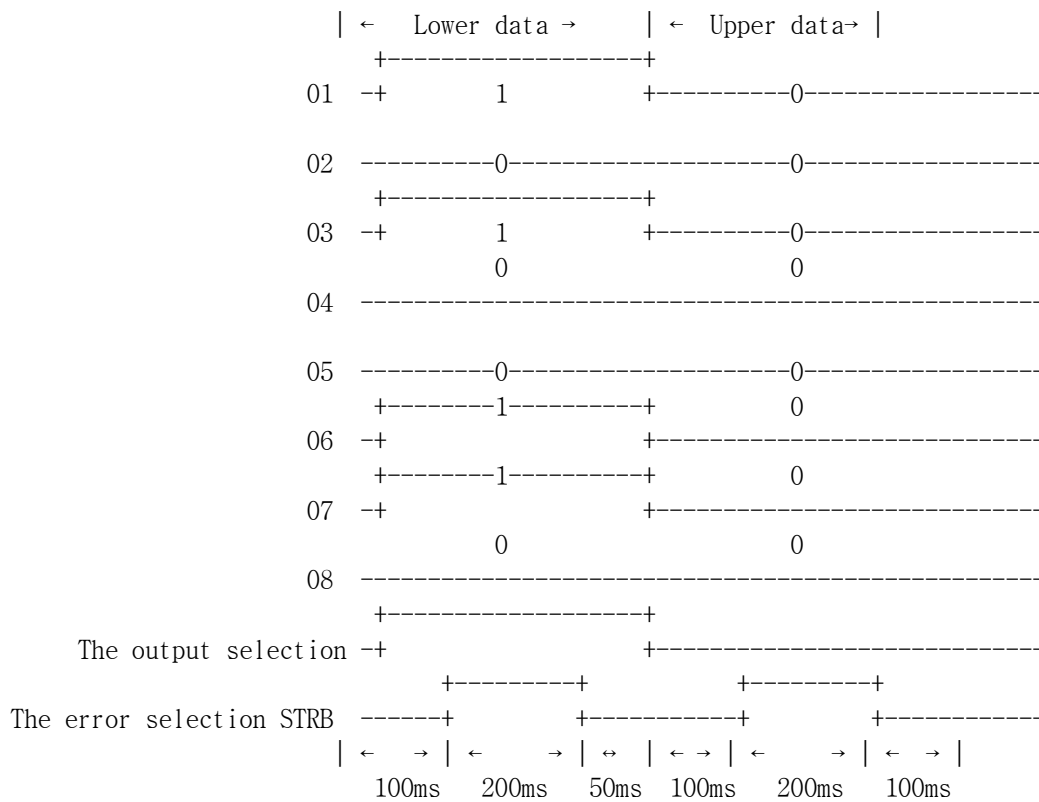
② Type 2 (16bit output)

It outputs 16bit data after the error number transfers the binary.
The strobe signal deciding the data check timing is
- System error => General error
- Operation error => Operation error
For example
The timing in case of occurring E0101(SYSTEM ERROR)

```
                      +-------1-----------------------------------
     01       ---+
                          0
     02       -----------------------------------------------------
                      +-------1-----------------------------------
     03       ---+
                          0
     04       -----------------------------------------------------
                          0
     05       -----------------------------------------------------
                      +-------1-----------------------------------
     06       ---+
                      +-------1-----------------------------------
     07       ---+
                          0
     08       -----------------------------------------------------
                          0
     09       -----------------------------------------------------
                          0
     10       -----------------------------------------------------
                          0
     11       -----------------------------------------------------
                          0
     12       -----------------------------------------------------
                          0
     13       -----------------------------------------------------
                          0
     14       -----------------------------------------------------
                          0
     15       -----------------------------------------------------
                          0
     16       -----------------------------------------------------

  Operation error ---------------------------------------------------
                      +---------------------------------------------
    General error ---+
```
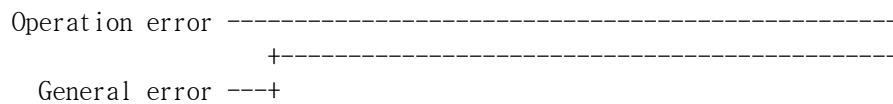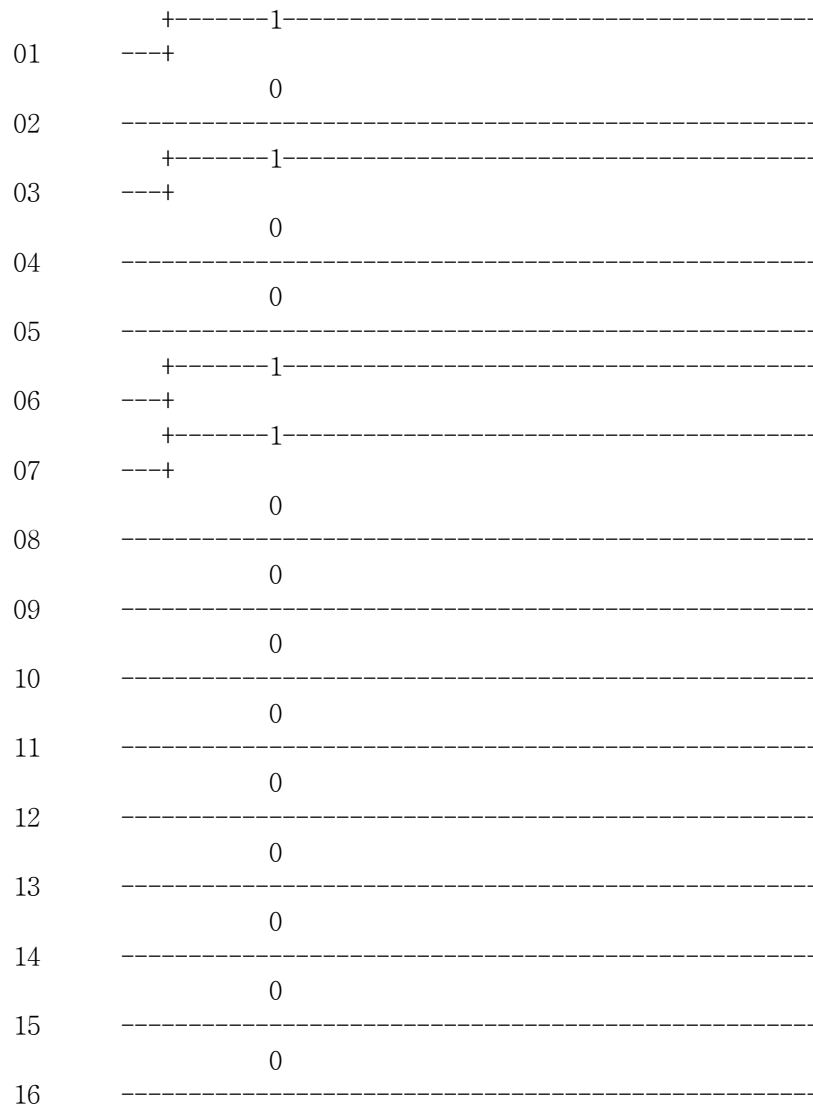
6.2.9 Power Saving : PWM OFF

Outline

It sets up the waiting time until the power saving function start from the last operation time.

It economizes on the consumption power by cutting off the power supply of the motor if the waiting time pass in case of the stop status for a long time resulting in input signal wait, starting wait of the robot in auto mode.

Screen display

```
14:39:38   *** Power saving ***  A:0 S:4
Power saving     = < Disable,Enable >
Waiting time     = [  12.8] min




Press [SHIFT]+[<-][->] Key.
>
```
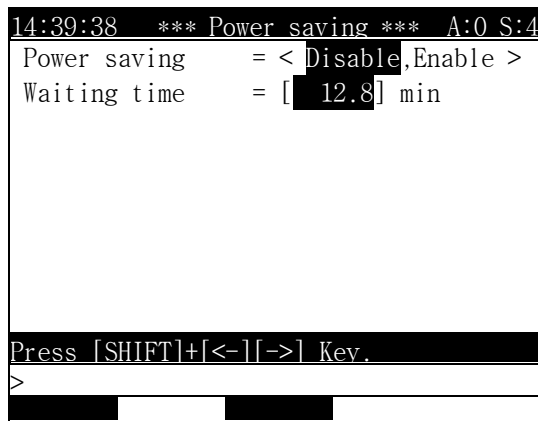
Screen description

■Power saving function: It sets up whether power saving function uses or not.

① Disable : It doesn't use the power save mode.

② Enable : It uses the power save mode.

■ Waiting time : It sets up the transferring time getting start the power save mode.

Reference

(1) If you press " Complete" [PF5]key, Save the changed information. if press [CANCEL] key , Cancel them.

6.2.10 Shift Limit

Outline

It sets up the limit value of the volume to be shifted.

It occurs the error if the shift volume is over the limit value that you set the limit value of the value to be shifted using in the XYZ SHIFT, ON-LINE SHIFT function.

Name	Content	Setting value
X axis direction limit	It is a limit value of X axis direction.	200 mm
Y axis direction limit	It is a limit value of Y axis direction.	200 mm
Z axis direction limit	It is a limit value of Z axis direction.	200 mm
X axis angle limit	It is a limit value of X axis angle.	20 deg
Y axis angle limit	It is a limit value of Y axis angle.	20 deg
Z axis angle limit	It is a limit value of Z axis angle.	20 deg
Shift Estimation	Option	5.0 mm

Screen display

```
14:39:38  *** Shift limit ***  A:0 S:4
Axis  Direction limit  Angle limit
X   = [ 200.0] mm      [  20.0] deg
Y   = [ 200.0] mm      [  20.0] deg
Z   = [ 200.0] mm      [  20.0] deg
    Shift evaluation value = [  5.00] mm




Select and Enter number. Press [SET]
>[0 - 9999.9]
```

Reference

⑴ If you press "Complete" [PF5]key, Save the changed information. if press [CANCEL]
   key , Cancel them.

6.2.11 Setting the user key

Outline

It uses this function after assigning some function in f1 ~ f4 key of the teach pendent
when the user wants to operate the robot easily.

For example

No.	f key	Content
0	Setting cancel	It cancels the set content.
501	GUN2	This the key for GUN2, same function to GUN key
	[f?]key	It turns " G2" ON/OFF in status line of manual mode
	[Enable]+[f?]key	The GUN2 signal outputs manually.
502	MX	It operates the MX status(ON/OFF).
	[f?]key	It turns " MX" ON/OFF in the status line of manual mode
	[Enable]+[f?]key	The MX signal outputs manually.
503	Tool selection	It selects Tool Number.
	[f?]key	It describes " T0~T3" in status line of manual mode.
	[Enable]+[f?]key	There is no function.
509	Speed 5% Up	The recorded speed in presently selecting program goes up 5% at one time. It doesn't change the speed between the step recorded block mark in case of being the step recorded block mark.
	[f?]key	The recorded speed goes up 5% at one time.
	[Enable]+[f?]key	No function.
510	Speed 5% Down	The recorded speed in presently selecting program goes down 5% at one time. It doesn't change the speed between the step recorded block mark in case of being the step recorded block mark.
	[f?]키	The recorded speed goes down 5% at one touch.
	[Enable]+[f?]키	No function.
523	MX2	This is the key for MX2, same function to MX(502) key.
	[f?]key	It turns "MX2" ON/OFF in status line of manual mode..
	[Enable]+[f?]키	The MX2 signal outputs manually.
524	GUN MANUALLY OPEN/CLOSE	This is the key to decide whether the servo gun is a big open or small open.
	[f?]key	No function
	[Enable]+[f?]key	This is the function that move only when you press the open/close key as the stroke length as you set in the servo parameter.
525	Manually gun pressure	This is the key to decide manual pressure of the servo gun.
	[f?]키	No function
	[Enable]+[f?]key	This is the function that the servo gun pressure only when you press the key with present pressure power.
526	Manual welding condition no. selection	This is the key to set up servo gun welding condition no. by manual.
	[f?]key	It changes the W value of W:1S:0 in the status of manual mode.
	[Enable]+[f?]key	No function
527	Manual welding sequence no. selection	This is the key to set the servo gun welding sequence no. by manual.

Screen display

```
14:39:38 *** f-key setting *** A:0 S:4
 f1=[  0]  f2=[  0]  f3=[  0]  f4=[  0]
     0     :Key setting cancel
     501   :GUN2
     502   :MX
     503   :Tool selection
     509   :Speed up by 5%
     510   :Speed down by 5%
     523   :MX2
     524   :Servo GUN open/close
     525   :Servo GUN squeeze
     526   :Welding condition selection
 ------------------------------------
 f1=[  0]  f2=[  0]  f3=[  0]  f4=[  0]
     527   :Welding squence selection


 Select and Enter number. Press [SET]
 >[0 - 527]
              Previous  Next  Complete
```

Reference

⑴ If you press " Complete" [PF5]key, Save the changed information. if press [CANCEL]
   key , Cancel them.

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6.2.12 Coordination system registration

Outline

It sets up the User coordination system or pedestal tool coordination system.

Screen display

```
14:39:38 *Coordinate assignment* A:0 S:4
   1: User coordinate
   2: Stationary tool coordinate




Use [Number]/[Up][Down] and press [SET].
>
            Previous  Next
```
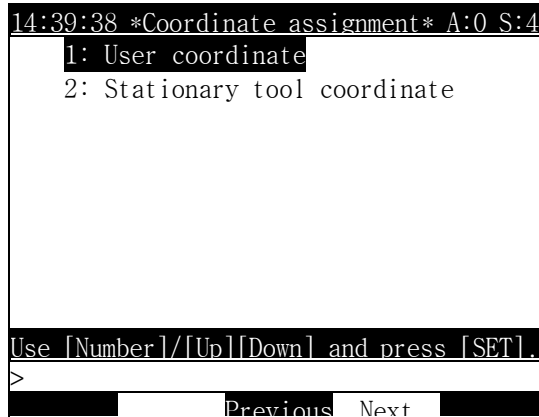
9.2.12.1 User coordination registration

Outline

This is the registration of User coordination system that register, define the coordination system, This means the coordination system that the user set up freely It is different from robot coordination and tool coordination.

Procedure

To register the User coordination system need the procedure that defines coordination system as you want in advance. This describes by teaching the program that have 3 reference points (3 steps) defining the user coordination system.
Teaching method of 3 reference step to define the user coordination system

1) Step 1 : This is the step to define the zero point of user coordination.

2) Step 2 : This is the step to define the X axis of the User coordination.

3) Step 3 : This is the step to define the plain of XY of the User coordination
           system , to decide the direction of Y axis and Z axis.

Screen display

```
14:39:38 *** User coordinate *** A:0 S:4

User Coord. No. = [  0]
Program No. for registration = [  0]




Select and Enter number. Press [SET]
>[1 - 10]
```
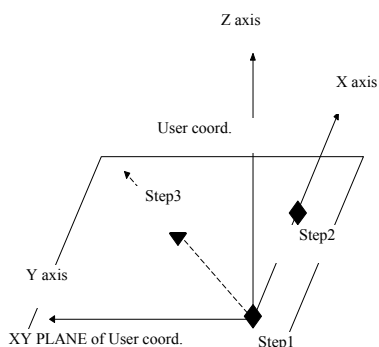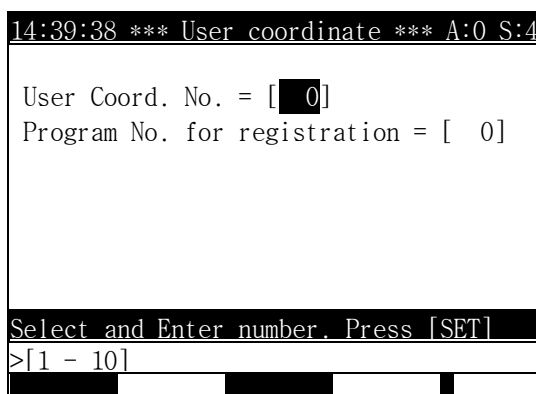
Screen description

■ User coordination system No. : This is the number that will use as User coordination
   system.

■ Program No. to register : This is the number that will register as User coordination
   system.

Reference

(1) You can register up to total 10 User coordination system.

(2) Caution when record of the reference point to define the system.
   ① There aren't 3 reference points in the same straight line.
   ② Please doesn't make too narrow the length between 3 reference points.
   ③ Steps after step no. 4 doesn't make any effective on the coordination
   system registration.

(3) If you press "Execute" [PF5]key, Save the changed information. If press [CANCEL]
   key , Cancel them.

(4) Please refer to the "Condition Setting" [PF5] → 7. User Coordination system

6.2.12.2 Pedestal tool coordination system

Outline

It selects the position of tool end of pedestal tool in the outer of the robot.

You can input the XYZ coordination about the pedestal tool number. It is possible for you to register 4 positions from 0 to 3.

XYZ coordination of tool end point of pedestal tool should input Base coordination of the controller. Usually Base coordination of controller is the robot base coordination.

Actual screen

```
14:39:38 *** Staionary tool *** A:0 S:4
Staionary tool 0
X0=[      0.0] Y0=[ 1000.0] Z0=[      0.0]
Staionary tool 1
X1=[      0.0] Y1=[ 1000.0] Z1=[      0.0]
Staionary tool 2
X2=[      0.0] Y2=[ 1000.0] Z2=[      0.0]
Staionary tool 3
X3=[      0.0] Y3=[ 1000.0] Z3=[      0.0]

Select and Enter number. Press [SET]
>[-5000.0 - 5000.0]
```

Reference

You can use the process as followings to know the position of the pedestal tool with the robot coordination system..
First, You must calibrate accurately axis constant and tool constant. You can calibrate the tool constant and axis constant with using " SYSTEM" [PF2] → 6. AUTO CONSTANT SETTING".

You should match accurately the tool end of pedestal tool end to the tool end of the robot. At this time, the position of the tool end displayed on teach pendent inputs in the pedestal tool number.
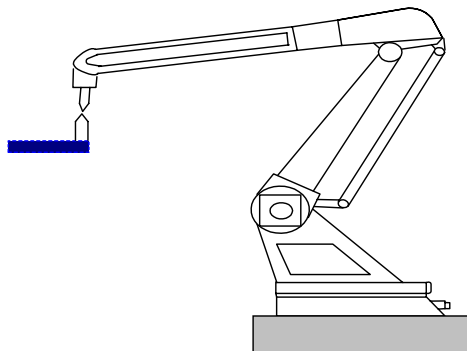
6.3 Machine Parameter

The following screen is displayed if you select the robot parameter.
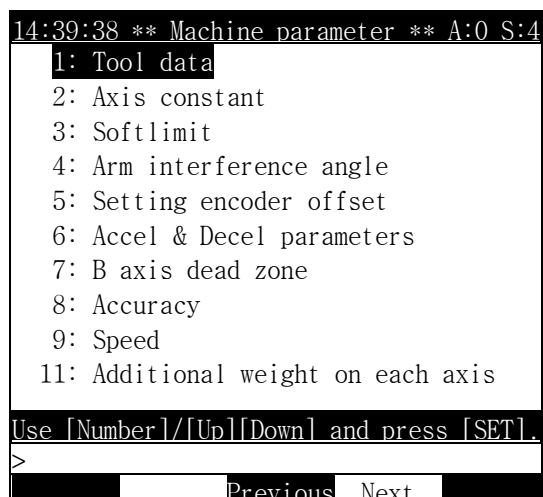
```
14:39:38 ** Machine parameter ** A:0 S:4
  1: Tool data
  2: Axis constant
  3: Softlimit
  4: Arm interference angle
  5: Setting encoder offset
  6: Accel & Decel parameters
  7: B axis dead zone
  8: Accuracy
  9: Speed
 11: Additional weight on each axis

Use [Number]/[Up][Down] and press [SET].
>
             Previous  Next
```

Selection method

① You can enter into the sub-menu if press [SET]Key after moving the highlights bar
   with using the arrow key to the item as you want to select.

② You can enter into the sub-menu if press [SET]Key after the item number as you want
   to select input with using the number key in the input frame.

Reference

■ The robot parameter store in the Machine constant file (ROBOT.C01).
■ You can't change in case that machine constant file (ROBOT.C01) is in all protection
   status.

6.3.1 Tool Data

Outline

You should register the length and angle of the tool. (Please register before teaching work) The robot does linear motion according to the setting length. The linear coordination motion or fixing motion of the tool end do the linear interpolation motion as you want if you must set the accurate value because the motion of the robot execute. and also, the tool angle decides the direction of the motion in case of tool coordination motion.

For example

The tool angle is the angle (Tn) of the end of the center of the R1 axis. as describing in the below feature. (n : Tool no. = 0 ~ 3) The tool length is the length to each axis direction in the end of the center of the R1 axis. (n : Tool no. = 0 ~ 3)

  (1)The length of X axis direction Xn (2) The length of Y axis direction   Yn
  (3)The length of Z axis direction Zn   (4) Rotation angle for X axis   Tn
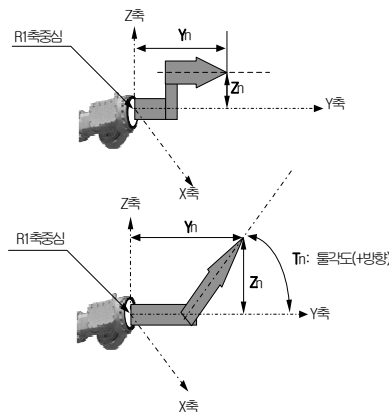
Screen display

```
14:39:38   ***  Tool data  ***  A:0 S:4
Tool 0 :::::::::::::::::::::::::::::::

Weight  [   120.0] kg

Component: X          Y          Z
Angle [    0.0] [    0.0] [    0.0] deg
Length[    0.0] [    0.0] [    0.00] mm

Inertia[  0.00] [   0.00] [    0.0]kgm2
Center[    0.0] [    0.0] [    0.0] mm
Use [Number]/[Up][Down] and press [SET].
>[0 - 1000.0]
AutoSETgAng SETgPrevious  Next
```

Screen description

■ Weight : Record the weight of tool.

■ Initia : Record the initia of the tool for tool coordination.

■ Center : Record the weight centering position of the tool basis on the R1 axis center.
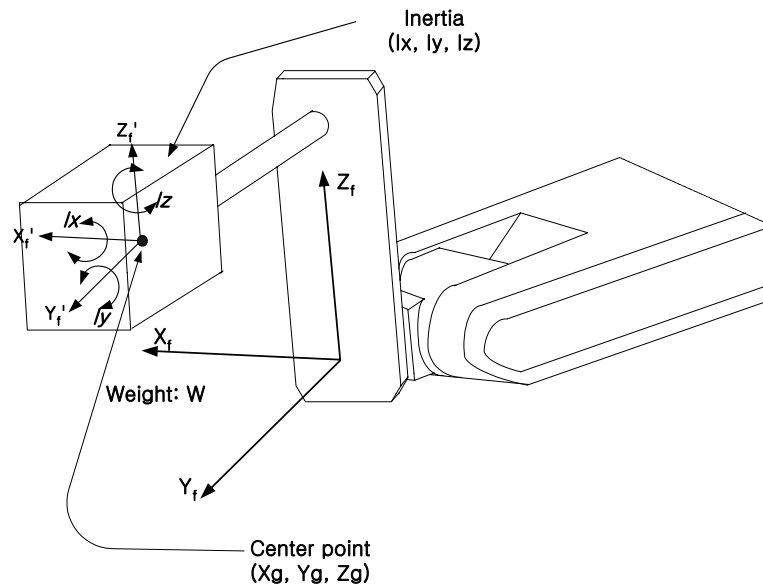
Finding method of the initia for a cylindrical tool and a square pillar below feature
is as following
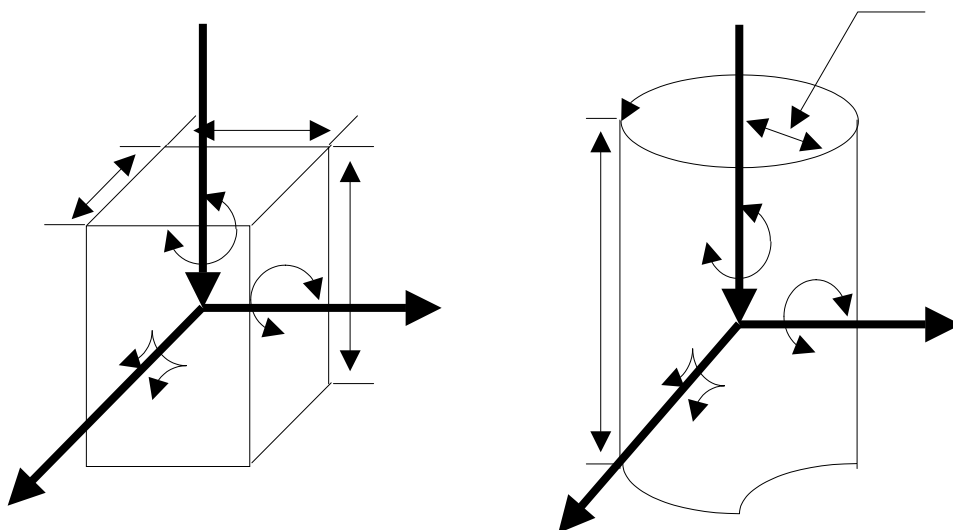
Initia calculation for square pillared tool   Initia calculation for a cylinderical tool

$Ix \approx \{ (Ly^2 + Lz^2) \} / 12 \times W$ $Ix \approx Iy \approx \{ (3r^2 + H^2) \} / 12 \times W$

$Iy \approx \{ (Lx^2 + Lz^2) \} / 12 \times W$ $Iz \approx \{ r^2 \} / 2 \times W$

$Iz \approx \{ (Lx^2 + Ly^2) \} / 12 \times W$

UNIT : WEIGHT[kg], LENGTH[m], INITIA[kg{m^2}]

Reference

(1) Auto calibration

    Outline

    You can make the same program to the previous program by calibrating automatically the tool constant without teaching when the teaching point in the previous program is different from the previous teaching point resulting in changing, modification of the tool.

    You can get angle, length of new tool if executing the function after moving the setting tool in the step that taught previously.
At this time, the position data of the step that is taught is recorded as the pose data, accurate.

    Screen display

```
14:39:38 ***AUTO TOOL SETg***  A:OS:4
*) By jogging, place the tool-tip at
   the point of reference step, with the
   same pose just as it was positioned.
   If the pose is not certain, execute
   'Angle Setting' after this function.

                Program No. = [  0]
                Step No.    = [  0]
                Tool No.    = [  0]


Select and Enter number. Press [SET]
>[1 - 999]
                              Execute
```

    Screen description

    ■ Existed program no. : You should input program no. that is taught before modification of the tool.

    ■ Step no. : Input the step no. that will execute tool constant auto calibration.

■ Tool no. to be set : Input the tool number that you want to set again.

⑵ Angle calibration

　Outline

　It executes the calibration, angle setting of the tool.
　You should select " Angle calibration" [PF2] key.

　Screen display

```
14:39:38  ***TOOL ANGLE SETg***  A:0S:4
By jogging, let the tool be parallel to
z-axis at any point directing downward.
Then, Press PF5[Execute].
      /  ____                 : --->Torch
   / : //--HH :         H : H
    : //   HH :         H : H
    :      HH :  Body    H : H
  Torch    HH-          H  H -->Body
          H==H_          H     H
    Side   H  H   Front  H     H
   -view   -----    -view ------
Adjust angle by jogging, then push PF5
>
                              Execute
```

　Operation method

■ Please press "Execute [PF5]" after the direction of X, Y, Z of tool coordination
　that you want to define move the position of the robot to coincide with the direction
　of X, -Z, Y.

■ At this time, the direction that the tool end is gong to move is the direction of
　the tool coordination system.

　Reference

Position of the robot
for tool angle calibration and setting

Z tool

Y tool

Direction from
outside of screen to
inner side of screen

Z robot

Y robot
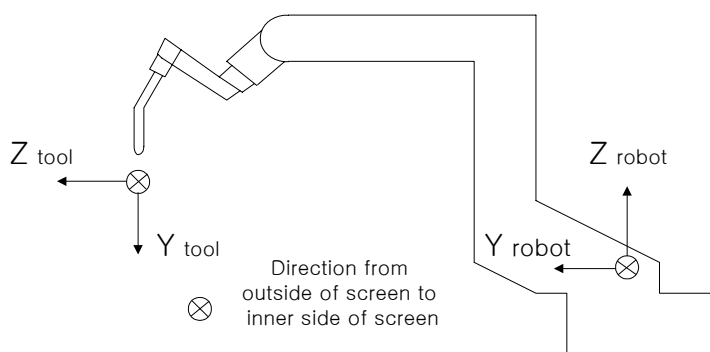
6.3.2 Axis Constant

Outline

It register the reference position of each axis.
It decides the direction of the linear motion by the axis constant.

It sets up the standard value when shipment. You need to change the constant of R1 axis according to the attaching direction of the tool, to change the constant of the S axis according to the situation of the robot and its peripheral device.

Screen display

```
14:39:38  *** Axis constants *** A:0 S:4
  S = [00400000]   [00400000] [     0.0]
  H = [00400000]   [00400000] [    90.0]
  V = [00400000]   [00400000] [     0.0]
  R2= [00400000]   [00400000] [     0.0]
  B = [00400000]   [00400000] [     0.0]
  R1= [00400000]   [00400000] [     0.0]


Use [Up][Down] Key and press [SET].
>
```

Screen description

■ S : Set up to the position that the axis angle by operating the Left/Right key is 0.

■ H : Set up to the position that the angle of H axis is 90 to the plain side.

■ V : Set up to the position that the angle of V axis is 0 to the plain side.

■ R2 : Set up to the position that R2 axis is 0.

■ B : Set up to the position that B axis is 0 when R2 axis is 0.

■ R1 : Set up to the position that R1 axis is 0 when R2 AND B axis is 0.

Reference
(1) If you press " END" [PF5]key, Save the changed information. If press [CANCEL] key , Cancel them.

6.3.3 Soft Limit

Outline

It sets to restrict the working range for each axis.

It sets the maximum working range of the robot when shipment in the production shop. Please reset according to the installation drawing when using in site.

Screen display

```
14:39:38  *** Software limit *** A:0 S:4
  S  LF=[0037FD56] [00400000] [     0.0]
     RG=[004802AA]
  H  FW=[003C5F00] [00400000] [    90.0]
     BW=[0043A100]
  V  UP=[003E8800] [00400000] [     0.0]
     DW=[004562AA]
  R2 DI=[0031899A] [00400000] [     0.0]
     RV=[004E7666]
  B  DI=[003ADA39] [00400000] [     0.0]
     RV=[004525C7]
Use [Up][Down] Key and press [SET].
>
              Previous  Next
```

Screen Description

■ S LF : It sets the restriction value of the right part of the S axis soft limit.
    RG : It sets the restriction value of the left part of the S axis soft limit.
■ H FW : It sets the restriction value of the forward part of the H axis soft limit.
    BW: It sets the restriction value of the backward part of the H axis soft limit.
■ V Up : It sets the restriction value of the upper part of the V axis soft limit.
    DW : It sets the restriction value of the down part of the V axis soft limit.
■ R2 DI : It sets the restriction value of the positive direction of the R2 axis soft limit.
     RV : It sets the restriction value of the reverse direction of the R2 axis soft limit.
■ B DI : It sets the restriction value of the positive direction of the B axis soft limit.
     RV : It sets the restriction value of the reverse direction of the B axis soft limit.
■ R1 DI : It sets the restriction value of the positive direction of the R1 axis soft limit.
     RV : It sets the restriction value of the reverse direction of the R1 axis soft limit.
■ It sets equally about the additional axis.

6.3.4 Arm Interference Angle

Outline

It sets the working limit between the ARM.

In case of the robot it restricts the angle between the H axis and V axis according to the robot structure. It sets the maximum working range between the arm when shipment.

Screen display

```
14:39:38  ** ARM interference ** A:0 S:4
    Min  = [   25.0]       [   90.0]
    Max  = [  155.0]




Use [Up][Down] Key and press [SET]
>
```
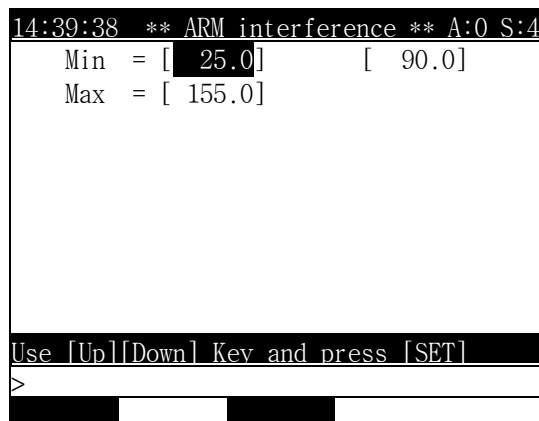
Screen Description

■ The minimum value : You can input the minimum value of the Arm interference angle (the minimum angle between H axis and V axis).

■ The maximum value : You can input the maximum value of the Arm interference angle(the maximum angle between H axis and V axis).

Reference

If you press " Complete" [PF5] key, Save the changed information. If press [CANCEL] key , Cancel them.

6.3.5 Encoder Offset Calibration

Outline

It calibrates the original point of encoder.

It decides the original point of the encoder to the position of the reference pin of each axis. You should calibrate the encoder to match the original point of encoder as actual encoder values according to each axis are various.
You should set this value again only when you exchange the encoder, motor because of setting this value when shipment.

Screen display

```
14:39:38 *** Encoder offset ***  A:0 S:4
           1: Encoder calibration(Position Rec)
           2: Encoder calibration(Data input)




Use [Number]/[Up][Down] and press [SET].
>
                     Previous  Next
```

6.3.5.1 Encoder Calibration (Position Record)

Outline

You can input the encoder calibration value by moving the axis.
The encoder value to be recorded is a HEX value.

Actual Screen

```
14:39:38 *** Encoder offset ***   A:0 S:4
  S = [00400000]   [00400000] [      0.0]
  H = [00400000]   [00400000] [     90.0]
  V = [00400000]   [00400000] [      0.0]
  R2= [00400000]   [00400000] [      0.0]
  B = [00400000]   [00400000] [      0.0]
  R1= [00400000]   [00400000] [      0.0]

Use [Up][Down] Key and press [SET].
>
```

position

offset

angle

---

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Operating Method

■ The following message is displayed if you press [SET] after moving the cursor to the position of the axis where you want to set.

```
After axis Oper, press [REC],[ESC]usable
>
```

■ It presses [RECORD] after moving the robot to the position of the reference pin with operation button.

Reference
If you press " Complete" [PF5] key, Save the changed information. If press [CANCEL] key , Cancel them.

6.3.5.2 Encoder Calibration (Numeric input)

Outline
You can input directly the encoder calibration value.
The encoder value to be recorded is a Decimal value.

Screen display

```
14:39:38 *** Encoder offset *** A:0 S:4
S =[          0] [          0][      0.0]
H =[          0] [          0][     90.0]
V =[          0] [          0][      0.0]
R2=[          0] [          0][      0.0]
B =[          0] [          0][      0.0]
R1=[          0] [          0][      0.0]



Use [Up][Down] Key and press [SET]
>[-2000000000 - 2000000000]
```

■ It presses [SET] after inputting the offset value with numeric key after moving the cursor to the position of the axis where you want to set.

Reference

⑴ If you press " Complete" [PF5]key, Save the changed information. If press [CANCEL] key, Cancel them.

6.3.6 Acceleration/Deceleration Speed Parameter

Outline

It sets acceleration/deceleration time.

It is a parameter that decides the maximum speed, acceleration/deceleration time of each axis of the robot. When the robot is made a shipment from robot shop, it is set to the most suitable value.
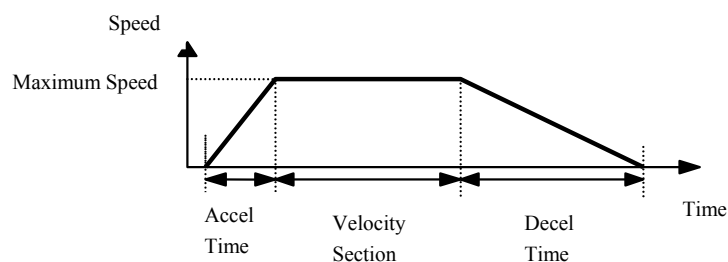
Screen display

```
14:39:38 ** Accel. Parameter **  A:0 S:4
Axis Max speed   Accel time  Decel rate
S =   [ 117]      [  80]      [   1]
H =   [ 120]      [  40]      [   1]
V =   [ 120]      [  60]      [   1]
R2=   [ 150]      [  25]      [   1]
B =   [ 150]      [  25]      [   1]
Select and Enter number. Press [SET]
>[1 - 9999]
```

Contents of the screen

■ Maximum speed   : It sets the maximum speed of each axis.

■ Acceleration time : It sets the time of acceleration section.

■ Deceleration ratio : It decides the deceleration time as the ratio on the acceleration/deceleration time.

   $Deceleration~time = Acceleration~time \times \{100 / (100 - Deceleration~time)\}$

Reference

(1) It displays the auxiliary axis in case that it exists.

(2) Ordinarily, it can't be changed. but in case that you have to change it unavoidably, please inquire to the after service person of our company or operator.

6.3.7 B axis Dead Zone

It sets the B axis Dead Zone.

The turning center of R1 axis and R2 axis is approximately parallel in the vicinity of zero degree of B axis. In this case, the robot is put in sudden movement with a little operation.

The vicinity of zero degree of B axis is called to Dead Zone. The controller adjusts automatically the movement of robot so that the movement of the wrist axis doesn't be more by free.

Screen display

```
14:39:38 ** B axis dead zone ** A:0 S:4
Setting value = [10] deg
Interpolation = <Position, Error-stop >




Enter number and press [SET]
>[0 - 90]
```

Contents of the screen

■ Setting value : It inputs the judgment angle of B axis Dead Zone.

■ Interpolation Execution Method
  ① Position Interpolation : It maintains the locus of only tool end without pose interpolation.

  ② Error Stop : When the robot is in the B axis Dead Zone, it makes the robot stopped by treating as error.

Reference

(1) If [PF5] key which means "Complete" is pressed, the information which is   changed is saved. Conversely, if [ESC] key is pressed, it is cancelled.

6.3.8 Accuracy

Outline

It sets the extent of coincidence with a destination position at the playback.

The range of accuracy is registered from zero to three. There are bit specifying type and distance specifying type in the specification of accuracy value.

In case that the step to move and next step are recorded as interpolation ON, the accuracy at the recorded point is automatically specified by distance. It is set with the standard value at the shipment from robot shop. Please set it again according to the circumstances.

< Accuracy Level >

Classification / Level	Bit specification (X = 0 ~ 9)	Distance specification (Standard value at the shipment)
Accuracy 0	128 X + 128	5 mm
Accuracy 1	256 X + 128	10 mm
Accuracy 2	640 X + 128	50 mm
Accuracy 3	3200 X + 128	100 mm

※ But in case that X equals to 10, accuracy check isn't executed.

Screen display

```
14:39:38    *** Accuracy ***    A:0 S:4
   Level        Bit      Distance
    0    =    [  2]    [   5.0] mm
    1    =    [  2]    [  10.0] mm
    2    =    [  2]    [  50.0] mm
    3    =    [  2]    [ 100.0] mm




Select and Enter number. Press [SET]
>[0 - 10]
```

Reference

(1) In case of the gun step, without having concern with accuracy, it is 196bit in the interpolation OFF and in the interpolation ON, it restricts to that the distance isn't bigger than 1.0mm.

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⑵ Discontinuous step / Continuous step

① Discontinuous step : It means a step to move off on the aimed step.
The move-off point is a point which the current value (feedback encoder) reaches
to the accuracy level (Bit, Distance) designated in the step.

② Continuous step : It means a step which doesn't have the move-off point.
There are steps that the cornering is possible and impossible step in the
continuous step.

⑶ Step that the cornering is possible

① The step that the cornering is possible shifts after planning the route between
two steps. The step that the cornering is possible is the same as following. There
are P(Interpolation OFF), L(Straight Line Interpolation) and C(Circular Arc
Interpolation) in the interpolation type which supports in the Hi4 controller.
The continuous system which supports the cornering in these types is L-L, L-J,
J-L, C-J, J-C and J-J.

※ Only, the step which the coordinate system changes(for example, such case as
it shifts for the direction of the positioner motive interpolation step from the
robot tool interpolation) is excluded in the cornering step.

Current step interpolation method	Next step interpolation method	Cornering
MOVE L	MOVE L	O
MOVE L	MOVE P	O
MOVE C	MOVE P	O
MOVE P	MOVE P	O
MOVE P	MOVE L	O
MOVE P	MOVE C	O
Pedestal tool straight line interpolation	Pedestal tool straight line interpolation	O
SMOV L	SMOV L	O
SMOV L	MOVE P	O
SMOV C	MOVE P	O
MOVE P	SMOV L	O
MOVE P	SMOV C	O
The case of continuous step except those		×

② The locus of L-L cornering

The L-L cornering is a method that plans the locus with a circular arc
between two locuci of continuous straight line. It corners describing the locus
of circular arc that circumscribes on the circle of accuracy range from two
straight lines and a point which is applicable to step1 in the following figure.
When replaying in the automatic mode, the locus should be checked in
advance due to shifting without reaching to designate step.

---
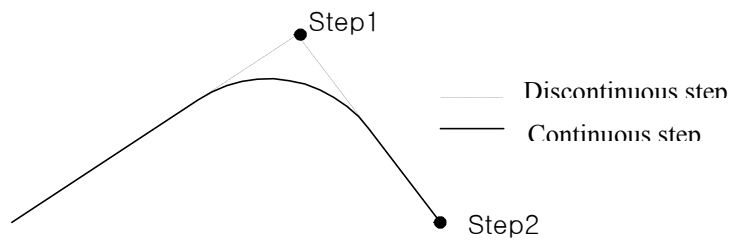
③ The locus of J-L and J-C cornering

If the J-L(or J-C) cornering enters in the accuracy range from the J step (Previous step), it plans to shift to the next step.
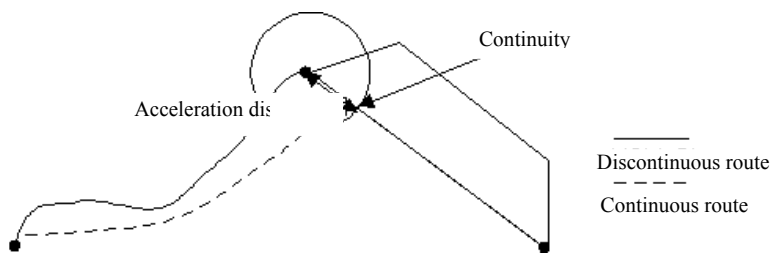
④ The locus of L-J and C-J cornering

If the L-J (or C-J) cornering enters in the accuracy range from the L step (Previous step), it plans to shift to the next step.
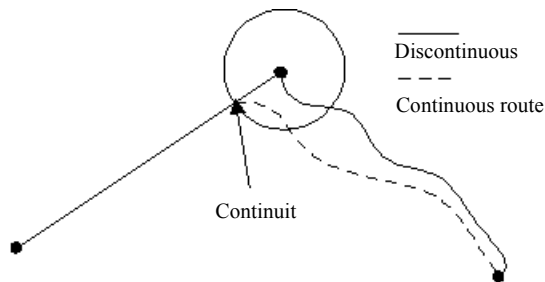
⑷ If [PF5] key which means "Complete" is pressed, the information which is changed is saved. Conversely, if [ESC] key is pressed, it is cancelled.

6.3.9 Speed

Outline

It decides the record speed in making a program.
It is a value that is recorded at the same time when you record the step. If it is
necessary, please set it again according to the use of robot.

There are from 1 level to 4 level in the high speed and from 1 level to 4 level in the
low speed in the playback speed to be recorded. It is recorded to already decided speed
in the following table according to level.

Classification / Level	Interpolation ON (Interpolation	Interpolation OFF (Joint action)
Low speed 1	10 mm/sec	12.50 %
Low speed 2	50 mm/sec	25.00 %
Low speed 3	100 mm/sec	37.50 %
Low speed 4	200 mm/sec	50.00 %
High speed 1	300 mm/sec	62.50 %
High speed 2	500 mm/sec	75.00 %
High speed 3	800 mm/sec	87.50 %
High speed 4	1200 mm/sec	100.00 %

Screen display

```
14:39:38      *** Speeds ***    A:0 S:4
Jog speed   INTPOLTN ON    INTPOLTN OFF
Low  1 = [   10] mm/sec   [ 12.50] [%]
     2 = [   50] mm/sec   [ 25.00] [%]
     3 = [  100] mm/sec   [ 37.50] [%]
     4 = [  200] mm/sec   [ 50.00] [%]

High 1 = [  300] mm/sec   [ 62.50] [%]
     2 = [  500] mm/sec   [ 75.00] [%]
     3 = [  800] mm/sec   [ 87.50] [%]
     4 = [ 1200] mm/sec   [100.00] [%]

Select and Enter number. Press [SET]
>[1 - 2300]
```

Reference

(1) If the [PF5] key which means "Complete" is pressed, the information which is changed
   is saved. Conversely, if the [ESC] key is pressed, it is cancelled.

6.3.11 Additional load per each axis

Outline

It registers the information of transformer or the supporting structure for wiring which equipped on the basic axis of robot and so forth.

Screen display

```
14:39:38* Additional mass set * A:0 S:4
 1'st Axis ===========================
 Weight[    0.0] Kg
Component:  X          Y          Z
Inertia[   0.00] [   0.00] [   0.00]Kgm2
Center[    0.0] [    0.0] [    0.0] mm

 2'nd Axis ===========================
 Weight[    0.0] Kg
Component:   X          Y          Z
Inertia[   0.00] [   0.00] [   0.00]Kgm2
Center[    0.0] [    0.0] [    0.0] mm
----------------------------------------
 3'rd Axis ===========================
 Weight[    0.0] Kg
Component:   X          Y          Z
Inertia[   0.00] [   0.00] [   0.00]Kgm2
Center[    0.0] [    0.0] [    0.0] mm


Select and Enter number. Press [SET]
>[0 - 1000.0]
                  Previous  Next  Complete
```

Contents of the screen

It inputs the load information of each axis by referring to the tool data of 6.3.1.

The coordinate system's origin on the each axis refers to the following figure. The X, Y and Z direction of each axis are set to the same direction with the coordinate system of robot.

Datum position of 3 axis

Datum position of 2 axis

Datum position of 1 axis
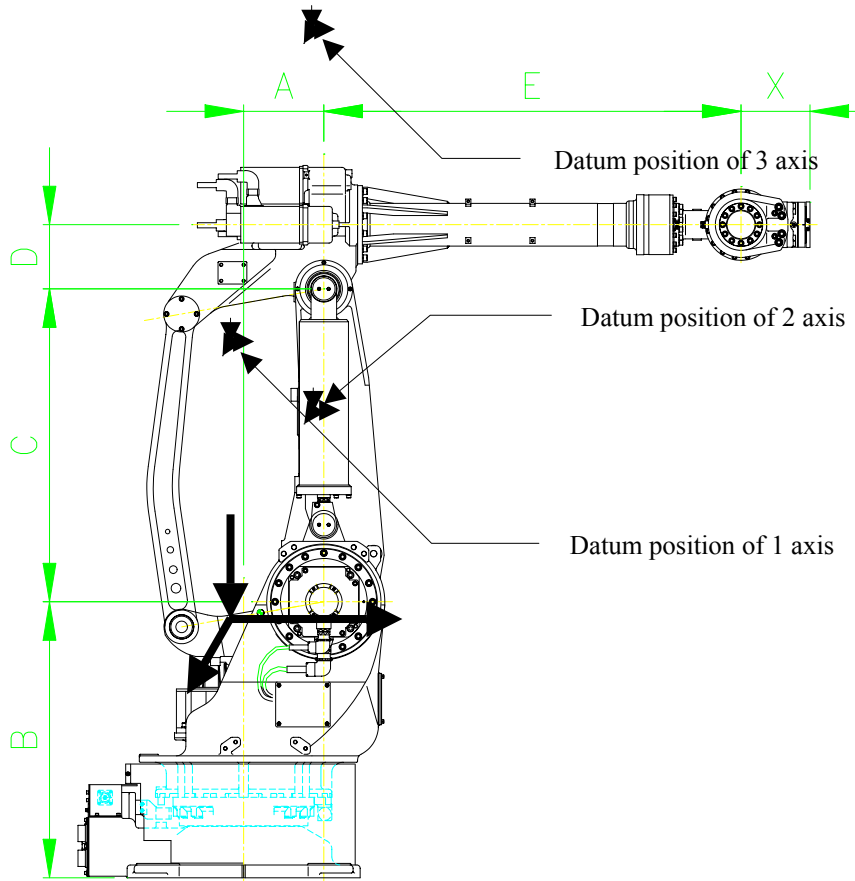
6.4 Application parameter

If you select the application parameter, the following screen is displayed.

```
14:39:38 *Application parameter* A:0 S:4
1: Spot & Stud
2: Arc
3: Palletizing
6: Conveyor
7: Volt. output proportional to Speed



Use [Number]/[Up][Down] and press [SET].
>
          Previous  Next
```
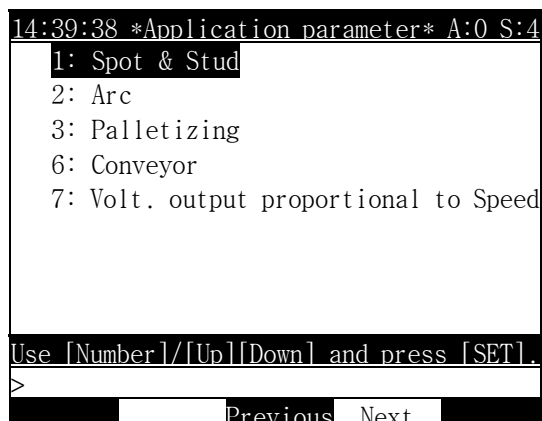
6.4.1 Spot & Stud

Outline

It is set to perform the spot & stud welding work.

Screen display

```
14:39:38 *** Spot&Stud Weld *** A:0 S:4
1: Air-gun welding data
2: Servo gun parameter
3: Servo-gun welding data(Cnd,Seq)
4: Air-gun equalizing parameter




Use [Number]/[Up][Down] and press [SET].
>
        Previous  Next
```
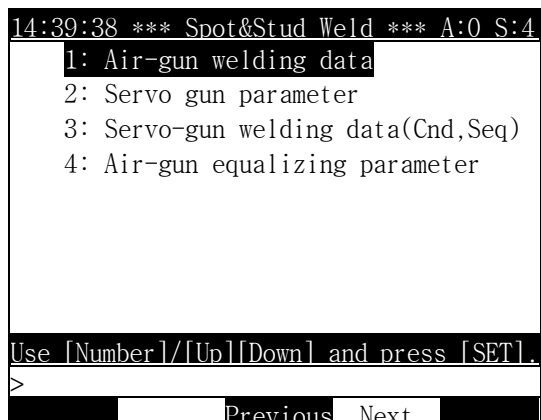
Reference

■ The welding parameter is taken in custody in the control constant file (ROBOT.C00) and the servo gun parameter and the equalizing parameter are taken in custody in the machine constant file (ROBOT.C01).

■ The spot welding data is taken in custody in the spot welding condition file (ROBOT.WSD).

■ In case that the control constant file, the machine constant file and the spot welding condition file are protected completely, it can't be changed.

6.4.1.1 Welding parameter

Outline

It makes the welding work possible efficiently to save the information that is necessary when it welds is a spot welding or stud welding.

Screen display

```
14:39:38 *Air-gun welding data* A:0 S:4
[Welding parameter]  = [ GUN1] [ GUN2]
GUN waiting time(sec) = [ 0.00] [ 0.00]
Robot WAITg time(sec) = [ 0.00] [ 0.00]
Brake WAITg time(sec) = [ 0.00] [ 0.00]
Sticking detect (sec) = [ 0.00] [ 0.00]
Rewelding count      = [    0] [    0]
Reweld wait time(sec) = [ 0.00] [ 0.00]
Slip detect range(mm) = [    0] [    0]
Slip detect count    = [    0] [    0]
Pulse width(0=level) = [ 0.00] [ 0.00]
Earlier gun time(sec) = [ 0.00] [ 0.00]
----------------------------------------
[Welding parameter]
Weld Cond Synchro  = <Disable,Enable>
Weld Cond out type = <Discrete,Binary>
Earlier Cond time  = [ 0.00]
WI common use      = <Disable,Enable>



Select and Enter number. Press [SET]
>[0.00 - 1.00]
          Previous  Next   Complete
```

Contents of the screen

■ Gun wait time (sec.) : It is a time when waits till the robot stops completely before outputting the gun signal.

■ Robot wait time (sec.) : It is a time when waits till the gun is opened completely after inputting the gun signal output and welding end signal. That is to say, it is a time when waits till the time the robot's movement starts after pressurizing the gun.

■ Brake wait time (sec) : It is a wait time to prevent the welding inferiority by calibrating the ON/OFF motion completion time of motor brake. It holds the motor brake because of the repulsion in the stud welding. It is a time when waits till the motor brake operates completely.

■ Weld stick detection (sec.) : It is a option.

■ Re-welding count : In case that the welding completion signal doesn't be inputted within the time set in the re-welding wait time after outputting the gun signal, it decides how many times the gun signal is outputted.

■ Re-welding wait time (sec.) : It sets a wait time till the re-welding.

■ Swerving error detection range (mm) : It means the range to display the error after detecting the slip of robot position by pressurization in doing the stud welding.

■ Swerving error detection count : After the exceeded frequency of swerving error detection range counts in doing the stud welding, if it exceeds the set frequency, it makes an error occurred .

■ Pulse width (0=level) : It decides whether to output the gun signal to the level or the pulse. In case of the level, it sets 0, and then the gun signal becomes OFF after inputting the welding completion signal (W1). And in case of the pulse, it sets the value that is bigger than zero, and then the gun signal automatically becomes OFF after outputting during the time when is set.

■ Gun signal first output time (sec.) : Usually, the gun signal is outputted. after a robot moves within the set accuracy range. but it sets the first output time in case of outputting gun signal before the robot arrives in the set range.

■ Welding condition synchronous output : Usually, the welding condition signal and the gun signal work differently. but, in case of outputting the welding condition signal synchronizing with gun signal, it is set to < Enable>.
① Disable : It doesn't use the welding condition synchronous output.
② Enable : It uses the welding condition synchronous output.

■ Welding condition output type : It decides whether to use the discrete type or the binary type for the welding condition signal.
① Discrete number : It can output the number of welding condition from 0 to 7(8EA).
② Binary code : It can output the number of welding condition from 0 to 255(256EA).

■ Welding condition first output time : When wanting to output the welding condition signal earlier than the gun signal, it is inputted.

■ WI common use : Usually, each welding completion signal is set to the Gun1, Gun2 signal, but in case that the air gun more than two uses, it is a data that decides whether to use the welding completion signal in commonness. The input signal assigned to WI(welding completion) in " System"[PF2] → 2.Control parameter → 1.Attribution of input/output signal → 7.Input signal assignment is
the WI signal for the Gun1 and Gun2.

① Disable : It doesn't use the WI(welding completion) signal in commonness.
② Enable : It uses the WI signal in commonness.

6.4.1.2 Servo gun parameter

Outline

It is set to do the spot welding by using the servo gun.

The additional axis should be registered to the servo gun and in case of making out the machine constant file, it is set to the initial value. If it is necessary, please change it according to the gun or the welding method so forth.

Please refer to the servo gun function manual for more precise contents.

Screen display

```
14:39:38* Servo Gun Parameter * A:0 S:4
    1: First(1) servo gun parameter
    2: Second(2) servo gun parameter




Use [Number]/[Up][Down] and press [SET].
>
            Previous  Next
```
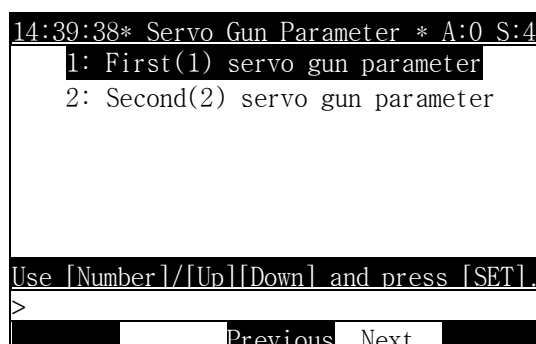
■ In case of using the multi-gun, it should be set on two items of the first and second servo gun parameter.
  If advanced to the first servo gun parameter, the following screen is displayed.

▶ In case of selecting the next screen

```
14:39:38** Servo Gun 1 Param.**A:0 S:4
Large stroke (mm)        = [    90]
Small stroke (mm)        = [    20]
Move tip clearance (mm)   = [  10.0]
Fix tip clearance (mm)    = [   2.0]
Max tip consumption (mm)  = [  10.0]
Tip change consumption (mm) = [   6.0]
Gun arm bent offset (mm)   = [  0.00]
Gun arm bent per 100Kgf (mm)= [  0.31]
Fix tip bent rate (%)     = [   100]
Pressure match rate (%)    = [     5]
Pressure fault check time(s)= [   3.0]
----------------------------------------
Max move tip consumption(mm)= [   0.0]
Max fix tip consumption (mm)= [   0.0]
Move tip change consumption = [   0.0]
Fix tip change consumption  = [   0.0]
Enter number and press [SET]
>
            Previous  Next  Complete
```

```
14:39:38** Servo Gun 1 Param. ** A:0 S:4
**Pressure-Current Tab.1 (Gravitational)
  Pressure(Kgf)  Command(A)  Feedback(A)
 1. [     50]     [     2]    [     2]
 2. [    150]     [     4]    [     4]
 3. [    225]     [     6]    [     6]
 4. [    300]     [     8]    [     8]
 5. [    350]     [    10]    [    10]




 ----------------------------------------
**Pressure-Current Tab.1 (Gravitational)
  Pressure(Kgf)  Command(A)  Feedback(A)
 1. [     50]     [     2]    [     2]
 2. [    150]     [     4]    [     4]
 3. [    225]     [     6]    [     6]
 4. [    300]     [     8]    [     8]
 5. [    350]     [    10]    [    10]


Enter number and press [SET]
>[50 - 999]
              Previous  Next  Complete
```

Contents of the screen

■ Large open stroke (mm) : It designates the distance that in case of the manual opening
  and closing (Enable+f), the movable electrode and the fixed electrode are opened
  to the maximum.

■ Small open stroke (mm) : It designates the distance that in case of the manual opening
  and closing (Enable+f), the movable electrode and the fixed electrode are closed
  to maximum. Also, it designates the distance that in case of the manual gun
  pressurization motions (Enable+f), the movable electrode and the fixed electrode
  are opened to the maximum.

■ Movable electrode clearance (mm), Fixed electrode Clearance (mm) : In case of
  replaying the spot welding function, it designates the pressurization starting
  position.

■ Maximum electrode abrasion quantity (mm) : In case of using the Gun search function,
  it decides the range of gun search. Two times value of the maximum electrode abrasion
  quantity becomes the search range. Also, in case that the total abrasion quantity
  detected with the gun search exceeds the maximum electrode abrasion quantity, it
  displays the error message such as "E0154" Total electrode exceeded the maximum
  abrasion quantity" and stops the playback. In case of being set to 0mm, it doesn't

check the abnormality of abrasion quantity.

■ Electrode exchange abrasion quantity (mm) : In case that the electrode's abrasion quantity detected with the gun search exceeds the electrode exchange abrasion quantity, it displays the warning message such as "W0105 Total electrode exceeded exchange maximum abrasion quantity" and informs the exchange of electrode by outputting the electrode abrasion warning signal. In case of being set to 0mm, it doesn't check the abnormality of abrasion quantity.

■ Gun arm bending offset quantity (mm) : To originate the pressurization force, the fixed electrode bending of a certain extent occurs. Like this, the bending of gun to generate the pressurization force is called to the gun arm bending offset quantity. In case of replaying the spot welding function, it pressurizes the position of movable and fixed electrode after compensating as the quantity of offset.

■ Gun arm bending quantity/100Kgf (mm) : It sets the bending quantity of gun arm by the pressurization force to the bending quantity per 100kgf. In case of replaying the spot welding function, it pressurizes the position of fixed electrode after calculating and compensating the gun arm bending quantity through this set point and the instruction pressurization force. The bending quantity of movable electrode doesn't be compensated.

■ Fixed electrode/Total bending (%) : In case that both fixed electrode and movable electrode bend when pressurizing, it sets the ratio of the bending quantity of fixed electrode per total bending.

■ Pressurization force accuracy (%) : When checking the pressurization accord, if the practical pressurization force reaches in the range of pressurization force accuracy comparing with the instruction pressurization force, it is recognized to the pressurization accord. In case of being set to 0, it doesn't check the pressurization accord.

■ Pressurization force error detection delay time (sec) : It sets the time when requires from the start of pressurization motions to the pressurization accord. In case of being in pressurization accord within this time, it immediately outputs the signal of sending an electric current at the moment of pressurization accord. If it is in pressurization accord within this time, it stops after outputting the error message such as "E1314 It exceeded the checking time of pressurization force accord". and if it is set to 0.0 second, it outputs the signal that is sending an electric current without checking the pressurization force accord.

■ Maximum movable electrode abrasion quantity (mm) : In case that the abrasion quantity of movable electrode detected with the gun search exceeds this set point, it stops

after outputting the error message such as "E0156 The fixed electrode exceeded the maximum abrasion quantity". and if it is set to 0.0mm, it doesn't perform the error detection.

■ Maximum fixed electrode abrasion (mm) : In case that the abrasion quantity of fixed electrode detected with the gun search exceeds this value, it stops after outputting the error message such as "E0156 The fixed electrode exceeded the maximum abrasion quantity". and if it is set to 0.0mm, it doesn't perform the error detection.

■ Movable electrode exchange abrasion quantity (mm) : In case that the quantity of movable electrode detected with gun search exceeds this value, it informs the exchange of electrode by outputting the warning signal after outputting the error message such as "W106 Movable electrode exceeded the exchange abrasion quantity. But in case of being set to 0.0mm, it doesn't perform the error detection.

■ Fixed electrode exchange abrasion quantity (mm) : In case that the quantity of fixed electrode detected with the gun search exceeds this value, it informs the exchange of electrode by outputting the warning signal after outputting the error message such as "W107 The fixed electrode exceeded the exchange abrasion quantity. But in case of being set to 0.0mm, it doesn't perform the error detection.

■ Pressurization speed (mm/sec) : When it performs the pressurization motions in case of replaying the manual gun pressurization (Enable+f), the pressurization of gun search and the spot welding function , it designates the movable speed of fixed electrode and movable electrode.

■ Instruction value offset (mm) : To generate the pressurization force in case of replaying the spot welding function, it makes the pressurization force generated by outputting the instruction of movable electrode so much as the instruction value offset distance for the direction of pressurization from the record position.

■ Gun type=<Robot gun, Pedestal gun> : In case of using the pedestal gun, it sets the coordinate system of pedestal gun to that of user. But in case that it isn't the pedestal gun, please set to the robot gun, and in case of using the pedestal gun, please set the number of user's coordinate system in the coordinate number so that the fixed electrode direction can be the Z direction of user's coordinate system. In case that the number of coordinates is set to "0", it becomes the coordinate system of robot.

■ Pressurization-Electric current table1(Gravity direction), Electric current table2 (Half-gravity direction) : It is used to adjust it in case that either the set pressurization force or the practical pressurization force exceeds the permitted limit in the measured value of pressurization force gauge. This electric current

pressurization table can set the current value on the pressurization of 5 unit choosed freely.

Reference

⑴ Certainly, set a data before using the servo gun function.

⑵ In case that the set point is improper, even if the "PF5"[Completion] key is pushed, it isn't changed. Therefore, please set to proper value again as follows.
   - The large open stroke should be set to being within the range of soft limit.
   - The small open stroke should be set to being smaller value than that of the large open stroke.
   - The movable electrode clearance should be set to being smaller value than that of the small open stroke.

⑶ In the multi-gun, it is possible in motor-off to register the pedestal gun. but in case of being set together with the robot gun, it can't do motor-on. therefore you should select either all of the robot guns or all of the pedestal guns.

⑷ The number of pedestal gun coordinate system is effective only in case of that the gun type is a pedestal gun.

⑸ The pressurization force-electric current table should be set by measuring with the pressurization force gauge because it can be different according as whether the movable electrode is a gravity direction or half-gravity direction.

⑹ Please refer to the specification manual on servo gun function for the precise contents of parameter.

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6.4.1.3 Spot welding data (condition, sequence)

Outline

It displays and changes the contents of a welding sequence data in the application
of servo gun.

The servo gun welding condition and sequence recorded in the spot welding
file(ROBOT.WSD) are datum which use in case that the spot welding function is
operated.

Please refer to the user manual on servo gun function for the precise contents.

Screen display

```
14:39:38*Servo-gun Welding Data* A:0 S:4
    1: Sequence common data
    2: Welding condition
    3: Welding sequence
    4: Welding data copy




Use [Number]/[Up][Down] and press [SET].
>
            Previous  Next
```
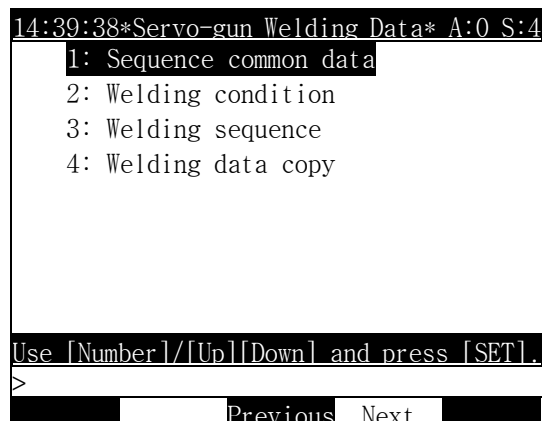
Reference

■ The spot welding data is taken in custody in the spot welding condition file
  (ROBOT.WSD).
■ It can be changed in case that the spot welding condition file (ROBOT.WSD) is
  completely taken in custody.

6.4.1.3.1 Common data

Outline

It is a data which is applied in commonness without having concern with the welding condition or sequence number.

Screen display

```
14:39:38   *** Common Data ***   A:0 S:4
Error processing  =< Interlock,Stop >
GUN open to error stop =< DSBL,ENBL >
WI  common use         =< DSBL,ENBL >




Press [SHIFT]+[<-][->] Key.
>
```

Contents of the screen

■ Treatment in the error : It is a treatment when the welding completion signal isn't inputted.

① Interlock wait : It wait until the welding completion signal is inputted.
② Stop : If the welding completion signal isn't inputted, it makes the robot stopped by treating as an error.

■ Gun open in the error/stop : It opens the servo gun and stops when the error or stop occurs under the welding.

■ WI common use : It is a data that decides whether the welding completion signal uses in commonness or not in case of using the servo gun more than two.
① Disable : It doesn't use the welding completion signal in commonness.
② Enable : It use the welding completion signal in commonness.

6.4.1.3.2 Welding condition

Outline

It is a data that decides the welding condition and the servo gun pressurization force so forth.

Screen display

```
14:39:38 *** Weld Condition *** A:0 S:4
Number        =[ 1]
Output data   =[  1]
Output type   =< Discrete,Binary >
Squeeze force =[ 50](Kgf)




Select and Enter number. Press [SET]
>

```

Contents of the screen

■ Number : It is the number that designates in the spot welding function and there are 64 unit.

■ Output data : It inputs the welding condition signal to output to the welder controller.

■ Output type : It is a data that designates the output type of welding condition signal. This item is fixed to binary.

■ Pressurization force (Kgf) : It inputs the data of servo gun pressurization.

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6.4.1.3.3 Welding sequence

Outline

It is a data that decides the welding sequence of controller in the playback of the spot welding.

Screen display

```
14:39:38  *** Weld Sequence *** A:0 S:4
Number                =[ 1 ]
Condition signal      =< DSBL,ENBL >
Squeeze signal        =< DSBL,ENBL >
Welding command signal =< DSBL,ENBL >
WI wait               =< DSBL,ENBL >
Welding wait time     =[0.00]
Welding end wait time =[0.00]


Select and Enter number. Press [SET]
>[1 - 64]
```

Contents of the screen

■ Number : It is the number that designates in the spot welding function and there are 64 unit.

■ Condition signal : It designates whether to output the welding condition signal or not. Currently, this item is fixed to <Enable>.

■ Pressurization signal : It designates whether to output the pressurization signal or not. Currently, this item is fixed to <Disable>.

■ Weld signal : It designates whether to output the weld signal or not. Currently, this item is fixed to <Enable>.

■ WI wait : It designates whether to do the welding completion wait or not after outputting the weld signal. Currently, this item is fixed to <Enable>.

■ Weld wait time : It designates the wait time of welding completion signal after outputting the weld signal. The 0.0 is the infinite wait.

■ Welding completion wait time : It designates the wait time of until the gun opens after completing the welding. But in case that the gun open time is short, the

welding completion wait is also come to an end.

6.4.1.3.4 Data copy

Outline

It can copy the data of welding condition number and sequence number to that of
other number.

Screen display

```
14:39:38   *** Data Copy ***    A:0 S:4
Selection =< Condition,Sequence >

Source number      =[ 1]
Destination number =[ 1]




Press [SHIFT]+[<-][->] Key.
>
```
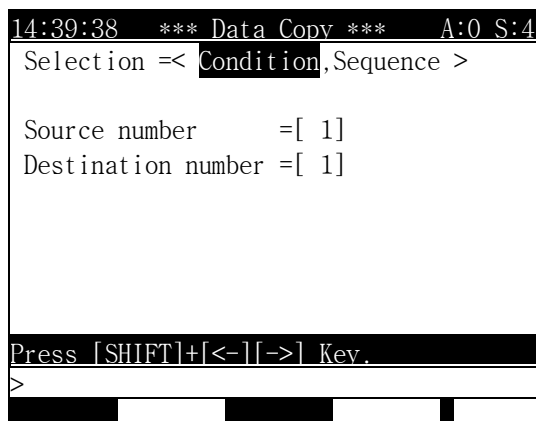
Contents of the screen

■ Selection : It selects that the data to copy is whether the welding condition number
  or the welding sequence number.

■ Data number to copy : It inputs the data number to copy. (1 - 64)

■ Data number to be copied : It inputs the data number to be copied.. (1 - 64)

Reference

(1) The spot welding data can be operated only in the servo gun
circumstances.

(2) It can change the data in process of the playback.

(3) The election of welding condition signal in the servo gun is impossible.

(4) The deposition in the servo gun is possible only through the detection
by the outside signal.

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6.4.1.4 Equalizing parameter

Outline

It is set to do the spot welding by using the equalizerless air gun.

The G1 or G2 should be <Eq'less> in "SYSTEM"[PF2] → 5.Initialization → 4.GUN mode
setting. If the initial value is set in making out the machine constant file, if
it is necessary, please change it according to the gun or the welding method.

Please refer to the specification manual on the robot equalizer function for the
precise contents.

Screen display

```
14:39:38* Equalizing Parameter *A:0 S:4
                        GUN1    GUN2
Fixed-tip clearance =[ 2.0]  [ 2.0]mm
Maximum consumption =[20.0]  [20.0]mm
Change consumption  =[10.0]  [10.0]mm
Search length of tip=[ 100]  [ 100]mm
Robot equalize speed=[  50]  [  50]mm/s
Guntype
=<Robot,Ext><Robot,Ext>
Coordinate number   =[   0] [    0]
            ( for Ext.(stationary) gun )
Enter number and press [SET]
>[0.0 - 20.0]
```

Contents of the screen

■ Fixed electrode clearance : It designates the pressurization starting position in
  the step that executes the order of gun pressurization.

■ Maximum fixed electrode abrasion quantity : If the abration quantity of fixed
  electrode detected with the gun search exceeds this value, it stops after outputting
  the error message such as "E0156 The fixed electrode exceeded the maximum abration
  quantity".

■ Fixed electrode exchange abration quantity : If the abration quantity of fixed
  electrode detected with the gun search exceeds this value, it informs the exchange
  of electrode after outputting the warning message such as "W0107 The fixed electrode
  exceeded the exchange abration quantity" and the warning signal of electrode
  abrasion. At this time, it doesn't stop replaying.

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■ Fixed electrode abration search distance : It is a parameter that decides the maximum range of the robot to move so as to measure the abrasion quantity of fixed electrode. The basis coordinate system of this gun search motions is a tool coordinate system and it inputs the aimed position by measuring the quantity to move for the direction of Z axis. In case of replaying after exceeding the fixed electrode abrasion search distance, it stops after outputting the error message such as "E1320 The sensor doesn't work in process of the gun search" and returning to the previous position of the gun search.

■ Robot equalizing speed : It is a speed that is necessary to move the fixed electrode equalizing motion to robot. The speed that the fixed electrode accesses to the test piece will be different according to this value.

■ Gun type : It sets the coordinate system of pedestal gun to that of user in case of using the pedestal gun. Please set to the robot gun in case of not pedestal gun.

Please set the number of user coordinate system in that of pedestal gun coordinate system in case of using the pedestal gun.
In case that the number of coordinate system is set to "0", it becomes the coordinate system of robot.

Reference

(1) Please set the data without fail before using the robot equalizer function.

(2) The number of pedestal gun coordinate system is enable only in case that the gun type is a pedestal gun.

(3) Please refer to the specification manual on the robot equalizer function for the precise contents of parameter.

6.4.2 Arc

Outline

It sets a function to do the arc welding.

Please refer to the "Operation manual on the HR controller" for the precise contents.

Screen display

```
14:39:38    *** Arc Weld ***    A:0 S:4
    1: Condition Parameter




Use [Number]/[Up][Down] and press [SET].
>
                    Previous  Next
```

Reference

■ The arc condition parameter is taken in custody in the control constant file (ROBOT.C00).

■ It can be changed in case that the control constant file (ROBOT.C00) is completely taken in custody.

6.4.2.1 Condition parameter

Outline

It sets a variety of condition for the welding work in the arc welding.

Screen display

```
14:39:38    ** Arc Weld **    A:0 S:4
 1: Fast step Go/Back = Max.speed*[  1]%
 2: Inching Spd: Slow=[  1]%,Fast=[  1]%
 3: Assign Welding Current Port  =[  0]
 4: Assign Welding Voltage Port  =[  0]
 5: Assign [ARC On] state output =[  0]
 6: Welder error input      =<DSBL,ENBL>
 7: Welding wire state      =<DSBL,ENBL>
 8: Shield Gas state        =<DSBL,ENBL>
 9: Feeder Ty=(Motor & Dir.)=<DSBL,ENBL>
10: Gas Postflow at weld stop =[ 0.0]sec
Enter number and press [SET]
>[1 - 25]
```

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Contents of the screen

1: High step forward/backward setting
It sets the speed in case of using the high speed movable function. That is to say,
it is the movable speed when the [SHIFT(high speed)] + [Step forward] and [Step
backward] are pressed.(Refer to the high speed movable function)

2: Inching speed setting
It is the wire feeding speed for the wire inching and the retract when using the
[Delivery],[Retreat] key. The wire speed is set at the rate of maximum speed. Also,
it sets the feeding speed of low speed or high speed(it works in pressing for more
than three seconds).(Refer to the Inching and Retract function)

3: Welding electric current instruction output port assignment ~ 5: [ARC On] key state
output signal assignment
It assigns the port number of every kind signal used in the arc welding. That is to
say, it decides the number of DI and AO.

6: Welder error state input ~ 8: Gas pressure state input
It decides whether to use a variety of the dedicated input signal used in the arc
welding or not.

9: [Inch.] output in case of [Retract]
It decides whether to output the delivery signal or not when pressing the [Retreat]
key for the welding wire retract.

10: Gas back-emission time in stopping in process of welding
It inputs the time when outputs the gas in the emergency stop in process of the welding
or when the robot is stopped by the outside error.

6.4.3 Palletizing

Outline

It sets the information that is necessary to use the palletizing function.

The GUN 2 should be set to the palleting in "SYSTEM"[PF2] → 5.Initialization → 4.GUN mode setting.

Please refer to the "Palletizing function manual" for precise contents.

Screen display

```
14:39:38   *** Palletizing ***   A:0 S:4
      1: Palletize pattern register
      2: Palette slope calculation




Use [Number]/[Up][Down] and press[SET].
>
             Previous  Next
```
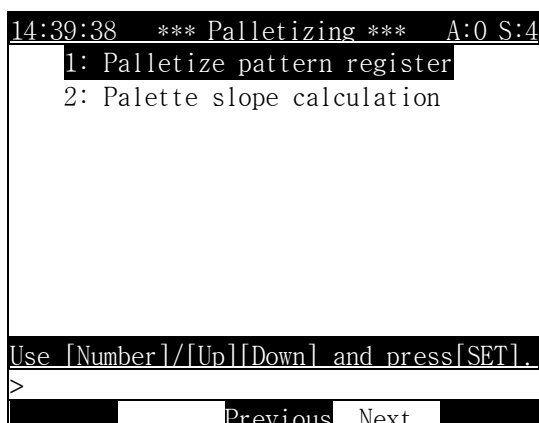
Reference

■ The palletizing pattern register is taken in custody in the palletizing pattern file (ROBOT.PAL).
■ It can't be changed in case that the palletizing pattern file(ROBOT.PAL) is completely taken in custody.

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6.4.3.1 Palletizing pattern register

Outline

It saves the information that is necessary to use the palletizing function.

It inputs the basic element to execute the palletizing function. To use the palletizing function, it has to be inputted.
It can save the "pattern register" of 16 unit at maximum. If it is necessary, please change it according to the palletizing loading pattern.

Screen display

```
14:39:38** Palletize pattern ** A:0 S:4
     1: Pattern register 1
     2: Pattern register 2
     3: Pattern register 3
     4: Pattern register 4
     5: Pattern register 5
     6: Pattern register 6
     7: Pattern register 7
     8: Pattern register 8
     9: Pattern register 9
    10: Pattern register 10
    11: Pattern register 11
--------------------------------------
_
    12: Pattern register 12
    13: Pattern register 13
    14: Pattern register 14
    15: Pattern register 15
    16: Pattern register 16



Use [Number]/[Up][Down] and press [SET].
>
           Previous  Next
```

■ 1: If the pattern register 1 is selected, the next screen is displayed.

```
14:39:38 ** Pattern Register **  A:0 S:4
#Palletize pattern Reg.No 01
Not use/use              =[       0]
Palletize/Depalletize    =[       0]
Pattern number(CNT/layter)=[      1]
Subpattern number        =[       1]
Total layter number      =[       1]
Even layer rotation      =<0,1,2>
Stacking direction       =<0,1,2,3>
Tool     =<Fork,Vaccum> User coord =[ 0]
Basic Workpiece=[   0.1][   0.1][   0.1]
Pallet slope   =[  0.00][  0.00][  0.00]
----------------------------------------
#Palletize pattern Reg.No 01
Slip compensation by work weight
St.layer=[    1]Shift(mm) =[   0.0]K=[  1]
Tier sheet insertion function
Tier sheet insertion =every [  0]tier
The last tier sheet      =<NO,YES>
Thickness of tier sheet  =[  0.1]mm


Press [SHIFT]+[<-][->] Key
>[0 - 1]
                  Previous  Next  Complete
```

Contents of the screen

■ Disuse/Use : It decides whether to use the present pattern register or not.

■ Palletizing/Depalletizing : It decides whether to execute the palletizing or depalletizing.

■ Pattern number(the number/first stage) : The pattern number is the total work object of one stage. There are patterns of 25 unit on the basis of the number of total work object which can stack on one stage. It sets the wishful pattern number.

■ Sub-pattern number : It divides the pattern of other shape classified by the pattern number. There are sub-pattrens of 6 unit which the loading shape and size are different each other. It sets the sub-pattern number of wishful shape.

■ Total stage number : It sets the total stage number to stack.

■ Even number stage loading rotative angle : It is to load all of the pattern by rotating properly in the even number stage to prevent the work object from falling down.

It is possible for even number stage to rotate 0 , 90   and 180   on the basis
of the basic pattern.
It means 0 = 0 , 1 = 90   and 2 = 180 . Generally, The even number stage comparing
with the odd number is loaded rotating 180 .

■ Loading direction : It decides the loading direction to decide the working order in
  loading the work object.

■ Handling tool : There are two cases which set this item.
  ㉠ The case that the position where picks up the work object is changed according
    to the kind of handling tool.
  ㉡ The case that the position where picks up the work object is changed according
    to the size variation of work object.
    The robot should correspond to the position variation that picks up the work
     object.

■ User coordinate system : The user coordinate system can use only in case that the
  "handling tool" is set to the "vacuum". The step that this user coordinate system
  is applied is applied only in the step which the step condition is "PK".(The PK
  means what picks up the work object(picking))

  The register of user coordinate system
      Step 1 : It defines the origin of user coordinate system.
      Step 2 : It defines the step that defines the X axis of user coordinate system.
      Step 3 : It is the step that defines the XY plane of user coordinate system
               and it decides the direction of Y axis and Z axis.

■ Basis work object size : It sets the size of basis work object.

■ Palette dip angle : It compensates as the quantity as inclined considering the
  Palette dip angle in piling up the work object. The compensating quantity is
  reflected by being increased and decreased on the shift quantity. It inputs the
  measured value after measuring the Palette dip angle.

■ Opening stage number : It inputs the stage number to shift the compensation of
  variation quantity.

■ Variation quantity : It inputs the value divided the total variation quantity by the
  applied stage number.

■ k : It reflects the weight of work object according to the extent of deflection value.

■ Letter-paper insertion basis : It sets the basis that inserts the letter-paper.

■ Last letter-paper existence yes or no : It decides the existence yes or no of letter
  -
  paper at the end.

■ Letter-paper thickness : It inputs the letter-paper thickness.

Reference

⑴ Certainly, set the data before using the palletizing function.

⑵ In case that the set point is unsuitable, even if you press the [PF5] key, the
   set point isn't changed. Therefore, please set to the proper value again as
   follows.
 - The GUN 2 should be set to the palletizing to set the palletizing pattern
   register.
 - In case of setting the pattern number and the sub-pattern number, please
   confirm the number that doesn't support.
 - Please refer to the Palette dip angle measurement for the Palette dip angle.
 - The letter-paper insertion basis can't be bigger than the total stage number.

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6.4.3.2 Palette dip angle measurement

Outline

It is a function that can measure the dip angle easily by making out the teaching
program separately for the Palette dip angle which is difficult to measure physically
in the workshop.

Screen display

```
14:39:38  ** Pallet slope **    A:0 S:4
Pallet slope teaching program  =[  1]
Palletize base step number     =[  1]
Palletize Rec.Posi(X Direct.)  =[  1]
Pallet Rec.Posi(Y Direct.)     =[  1]




Enter number and press [SET]
>[1 - 999]
```

Contents of the screen

■ Palette dip angle measurement program number : It inputs the program number made out
  to measure the dip angle.

■ Palette basis step number : It records the position step that the palette and the initial
  work object are to be put.

■ Palette X direction record step number : It records the step in the direction of X

  axis.(robot coordinate system basis)

■ Palette Y direction record step number : It records the step in the direction of Y
  axis.(robot coordinate system basis)

6.4.6 Conveyor

Outline

It sets a variety of parameter to use the conveyor synchronous function and also a variety of condition to decide the motions shape of conveyor synchronous playback.

The conveyor synchronism should be set to the <ON> in "SYSTEM"[PF2] → 5. Initialization → 2.Robot type selection.

Please refer to the "User manual on the conveyor function" for the precise contents.

Screen display

```
14:39:38    *** Conveyor ***    A:0 S:4
       1: Conveyor parameter setting
       2: Conveyor angle/centr auto-set




 

Use [Number]/[Up][Down] and press [SET].
>
           Previous  Next
```
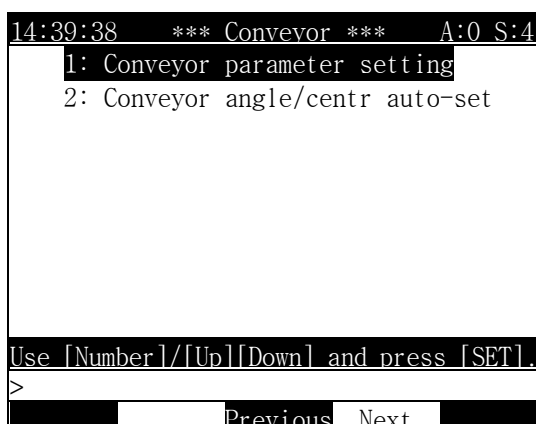
Reference

■ The conveyor constant is taken in custody in the control constant file.(ROBOT. C00)

■ It can't be changed in case that the control constant file(ROBOT.C00) is completely taken in custody.

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6.4.6.1 Conveyor constant setting

Outline

It sets a variety of parameter on the conveyor when intending to work by using the conveyor.

Screen display

```
14:39:38** Conveyor Parameter ** A:0 S:4
Conveyor  type            =<Lin.,Rot.>
Conveyor constant         =[   1000]
Lin. horizontal angle     =[    0.0]
Lin. Vertical angle       =[    0.0]
Rot. conveyor angle (X)   =[    0.0]
Rot. conveyor angle (Y)   =[    0.0]
Rot. conveyor center (X)  =[    0.0]
Rot. conveyor center (Y)  =[    0.0]
Rot. conveyor center (Z)  =[    0.0]
Sampling time             =[    0.10]
Allowed pulse error cnt.  =[      0]
----------------------------------------
_
Robot when CNVY stopped   =<Stop,GO>
Conveyor Max Frequency    =[   10.0]
Conveyor Max Speed        =[  150.0]
Repeated LS on       =<Count,Error,Ignore>
CNVY TRACKg during hold  =<DSBL,ENBL>
CNVY Pulse Count Type    =<UP,UP/DOWN>
CNVY System Error Detect =<ENBL,DSBL>


Press [SHIFT]+[<-][->] Key
>
               Previous  Next
```

Contents of the screen

■ Conveyor type : It sets the conveyor type that decides whether the work conveyor shape to work is a straight line or pattern. The conveyor of pattern type isn't supported at present.

■ Conveyor constant : It inputs the pulse number generated from the pulse producer when the conveyor moves 1m.

■ Straight line conveyor horizontal angle : It inputs the angle the advancing direction of conveyor rotates in the plus direction of robot coordinate system' Z axis center on the basis of X axis of robot coordinate system.

■ Straight line conveyor vertical angle : It inputs the angle the advancing direction of conveyor rotates in the plus direction of robot coordinate system' Y axis center on the basis of X axis of robot coordinate system.

■ Pattern conveyor X axis rotative angle : The pattern conveyor isn't supported at present.

■ Pattern conveyor Y axis rotative angle : The pattern conveyor isn't supported at present.

■ Pattern conveyor center X value : The pattern conveyor isn't supported at present.

■ Pattern conveyor center Y value : The pattern conveyor isn't supported at present.

■ Pattern conveyor center Z value : The pattern conveyor isn't supported at present.

■ Sampling interval : It is fixed to the 0.1 second at present.

■ Pulse error detection permissible count : Even if the pulse error is made, it makes the robot worked continuously to protect the work object in process of the synchronous work. For example, if the pulse error detection permissible count is set to 3, even if the pulse error in process of the synchronous work in the one work object is detected more than three time, the robot doesn't make an error but makes the synchronous work continued normally by making the proper pulse value artificially.

■ Robot in case of the conveyor stop : When the signal isn't inputted in process of operating the conveyor, that is to say, when the conveyor stops, it decides the movement of robot.
① Execution : In case that the signal isn't inputted in process of operating the conveyor, it stops after executing by the end of cycle in process of replaying. and then it waits for the starting signal.
② Stop : In case that the signal is inputted in process of operating the conveyor, it makes the robot stopped.

■ Conveyor permissible frequency : It sets the upper limit value of normal pulse number outputted from the conveyor pulse producer per one second. It is possible to input from 1kHz to 15kHz at present.

■ Conveyor permissible speed : It treats as the error in case that the conveyor speed is higher than the set permissible speed.

■ Even number work object advance : It decides the contents to treat it in case that another work object advances into the work space hitting the limit switch when the robot works at the one work object on the conveyor.
① Permission : It permits the advance of even number work objects.
② Error : It makes the robot stopped by making an error in case that the even number work objects are advanced.
③ Disregard : It disregards it even if the even number work objects are advanced.

■ Synchronism in case of robot's temporary stop : It decides whether to carry out the conveyor tracking or not in case that the robot temporarily stops by the input of stop order in process of replaying.
① Prohibition : It doesn't carry out the conveyor tracking in case that the robot stops by any cause in process of replaying.
② Permission : It carries out the conveyor tracking in case that the robot stops by the stop order or occurrence of error so forth.
       Please consult with the experts of our company for more precise contents.

■ CNVY pulse counting type : It is a item to announce the jump setting of pulse count circuit in the BD480 board to the controller.
① Jumper2(JP2) short of BD480 board : Up/Down count
② Jumper3(JP3) short of BD480 board : Up count

■ System error detection related with the synchronism : In case that the robot can't be the operation preparation ON by making the system error related with synchronism of conveyor due to the incompletion of system installation or board damage so forth, it can be set not to make an relative system error so as to do the motions that aren't related with the synchronous work such as making the robot moved to the position designated specially by the manual operation.

6.4.6.2 Automatic setting of the conveyor angle and center

Outline

In case that the direction of conveyor isn't paralleled to the X axis or Y axis of robot coordinate system when setting the horizontal/vertical angle of the conveyor, it isn't easy to measure the conveyor angle precisely which is in the space of three dimensions. It offers the method which can find the conveyor angle by the brief operation of user to remove the inconvenience such as this.

Screen display

```
14:39:38* Auto Conveyor Angle * A:0 S:4

Conveyor type          =<Lin., Rot.>
Program for automatic setting = [    1]




  Press [SHIFT]+[<-][->] Key
>
```
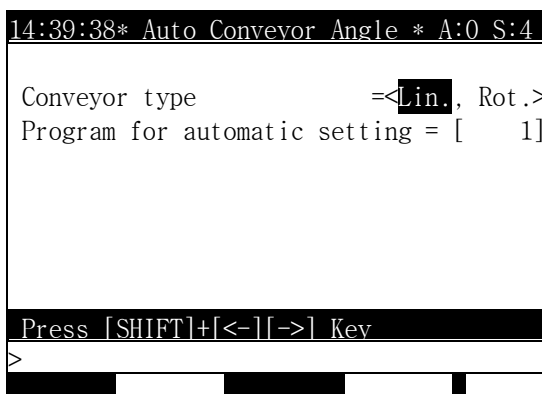
Contents of the screen

■ Conveyor type : It selects the conveyor type which wants to work with. The pattern conveyor isn't supported at present.

■ Program number for the automatic setting : The straight line conveyor records two points. The method which records the position is that at first, records one point after the tool end of robot indicates one point on the conveyor and then records additional one point after the tool end of robot indicates the same position on the conveyor by moving 1m approximately.

If the conveyor angle is found by the execution, the result is displayed as following screen.

```
14:39:38** Conveyor Parameter ** A:0 S:4

Conveyor type     =<Lin., Rot.>
Program for automatic setting = [    1]

Lin. conveyor horizontal angle =   12.0
Lin. conveyor vertical angle   =    0.0


Press [SHIFT]+[<-][->] Key
>
              Previous  Next
```

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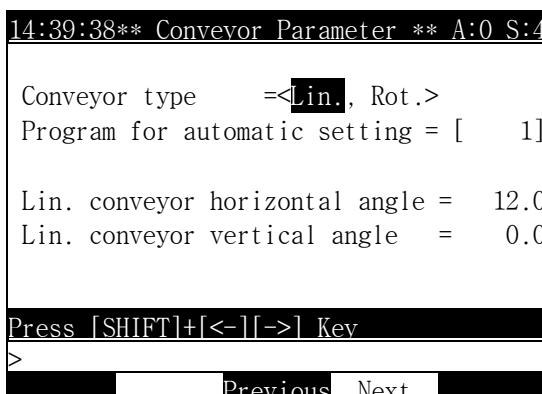
6.4.7 : Speed proportion voltage output

Outline

It makes the analog voltage in proportion to the tip velocity of robot outputted from the BD480 board.(option)

If the outputted voltage is used in combination with the sealing equipment for the voltage controller type, it is possible to maintain the discharge in the vicinity of the sealing beginning position and corner in doing the sealing work.
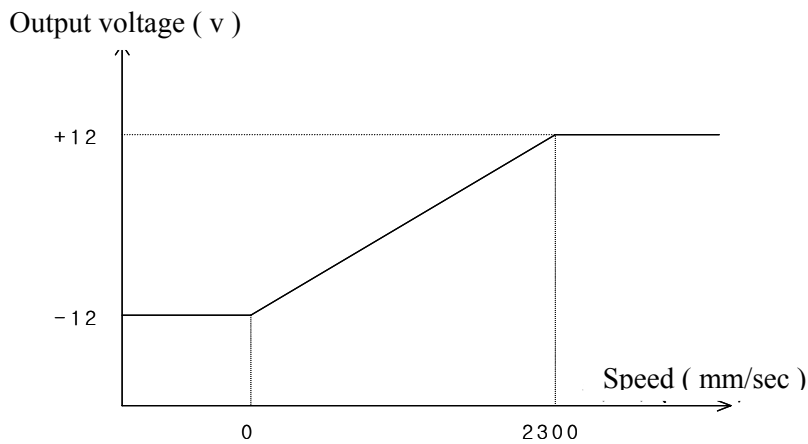
Output voltage (v)

The output of analog voltage is made through the TBAO terminal of BD411 board connected to the BD411 board and serial port.

(1) Specification of BD481 analog output part

Output channel number	4 channel
Output voltage range	-12.0V ~ +12.0V
DAC Resolution	0 ~ 3

(2) Analog output voltage per digital input value.

Digital input value	Analog output voltage
FFFh	+12V
800h	0V
000h	-12V

(3) Pin arrangement of analog output terminal

Terminal name	Pin number	Signal
TBA0	1	Channel 0 output
	2	AGND (Analog ground)
	3	Channel 1 output
	4	AGND (Analog ground)
	5	Channel 2 output
	6	AGND (Analog ground)
	7	Channel 3 output
	8	AGND (Analog ground)

Screen display

```
14:39:38 ** Speed by voltage **  A:0 S:4


Minimum voltage = [  -3.7] (V)
Maximum voltage = [  -0.2] (V)
Minimum speed   = [3368.0] (mm/sec)
Maximum speed   = [6524.0] (mm/sec)
Port No.        = [   160] 0=>No output



Select and Enter number. Press [SET]
>[-12.0 - 12.0]
```

Reference

(1) In case of selecting the " SERVICE"[PF1] → 1.Monitering → 19.Analog data,
    you can do the monitoring on the input/output state of analog input/output signal.
(2) The speed proportion output data is taken in custody in the control constant file.
    (ROBOT.C00)
(3) It can't be changed in case that the control constant file(ROBOT.C00) is completely
    protected.

6.5 System format

If selecting the initialization, the following screen is displayed.

```
14:39:38  *** System format *** A:0 S:4
1: System format
2: Selecting type of the robot
4: Positioner group setting
5: Positioner group setting



Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```
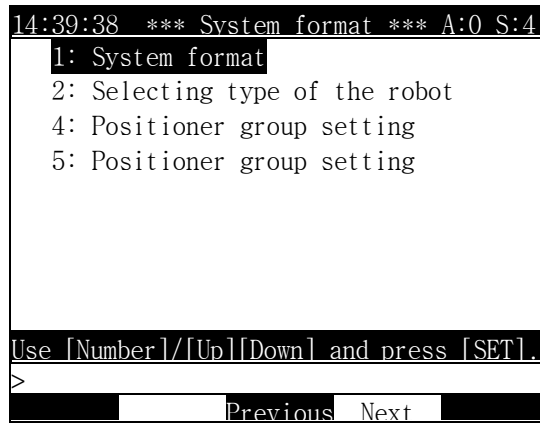
6.5.1 System format

Outline

It sets the control constant file (ROBOT.C00) to the value in the shipment from the robot shop after deleting all of the data being in the custody range of controller.

Screen display
If selecting the system initialization, the following message is displayed.

```
┌─────────────────────────────┐
│                             │
│Format?                      │
│>                            │
│           Previous  Next    │
└─────────────────────────────┘
```
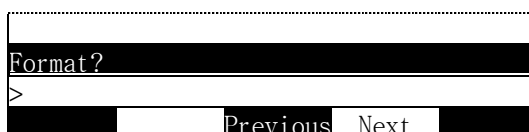
■ If pressing the [Yes] key, the format is progressed. But conversely, if pressing the [NO] key, it is canceled.

Reference
⑴ The following screen is displayed after the system initialization is progressed.

```
┌─────────────────────────────┐
│14:39:38    *** Format ***   ConsLock│
│   1: System format          │
│   2: Robot type selection   │
│                             │
│Use [Number]/[Up][Down] and press [SET].│
│>                            │
│  File                       │
└─────────────────────────────┘
```
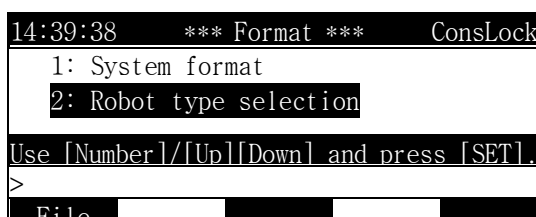
⑵ In case of selecting the system initialization, even if you initialize the system one more time, the same screen as that of the upside is also displayed.

⑶ If selecting the "File control"[PF1], the following screen is displayed. This is a function that is necessary to use the constant file made out at the former times when the constant file doesn't exist. The operating method is same as the "SERVICE"[PF1] → 5.File control.

```
┌─────────────────────────────┐
│14:39:38  *** File manager ***  EditLock│
│1: Rename                    │
│2: Copy                      │
│3: Delete                    │
│4: Protect                   │
│Use [Number]/[Up][Down] and press [SET].│
│>                            │
│ System                      │
└─────────────────────────────┘
```

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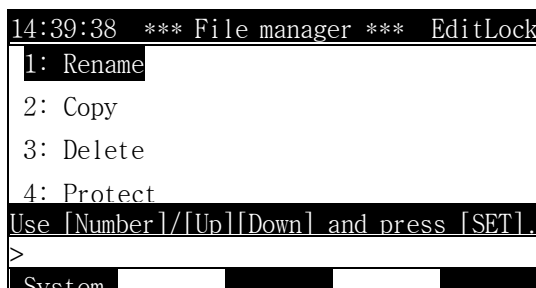
6.5.2 Robot type selection

Outline

It sets the machine constant file (ROBOT.C01) to the value in the shipment of controller from the robot shop and it is a function that a variety of record files are newly made out to the value set in the control constant file.

Screen display

```
14:39:38 *Robot type selection * A:0 S:4
      1: H120 (Matsushita motor)
      2: H150 (Matsushita motor)
      3: H150S
      4: H100P
      5: H120S-02
      6: H6-02 (without R2-cable coverty)
      7: H6-03 (with R2-cable cover type)
      8: H015-01 (Matsushita motor)
      9: H015-03 (Tamagawa motor)
     10: HR130-2
     11: HR165-2
Use [Number]/[Up][Down] and press [SET].
>
            Previous  Next
```
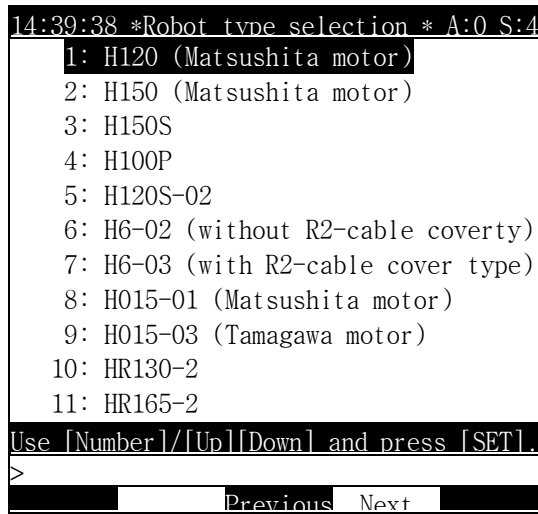
■ If selecting the name that accords with the robot manipulator, the following screen is displayed.

```
14:39:38 *Robot type selection* A:0 S:4
 H120
 The number of additional axes = [0]
Conveyor synchronization = <OFF,ON>
    Vibration control mode= <OFF,ON>




Enter number and press [SET]
>[0 - 6]
            Previous  Next
```
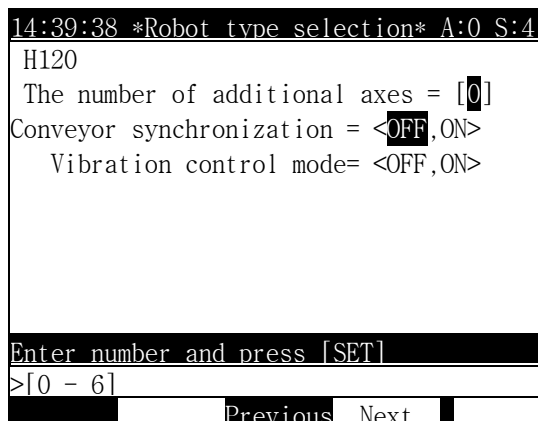
Screen description

■ Additional axis number : It inputs the number of additional axis in case that the additional axis exists. Because the additional axis number is set to the "0", in case

---

----

that the additional axis doesn't exist, if pressing the "Execution" key, the reconfirmation message is displayed as follows. If pressing the [YES] key, the constant file is made out and conversely, if pressing the [NO] key, it is cancelled.

```
┌─────────────────────────────────────┐
│                                     │
│ Make?                               │
│ >                                   │
│                 Previous  Next    ▌ │
└─────────────────────────────────────┘
```

■ Conveyor synchronism : When doing a work synchronizing with the conveyor, please set to the ON.

■ Vibration damping controller application : If you want to use the vibration damping controller, please set to the ON.

　Reference

⑴ If the system initialization isn't done, the following message is displayed. And if pressing the [Esc] key, you can begin it again.

```
┌─────────────────────────────────────┐
│                                     │
│ No system file. Need to format first│
│ >                                   │
│                 Previous  Next    ▌ │
└─────────────────────────────────────┘
```
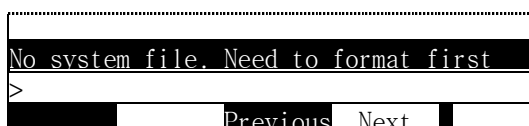
⑵ If the machine constant file(ROBOT.C01) exists, the following message is displayed. And if pressing the [YES] key, it is newly made out and if pressing the [Esc] key, it is cancelled.

```
┌─────────────────────────────────────┐
│                                     │
│ Warning! File exists. New?   [YES/NO]│
│ >                                   │
│                 Previous  Next    ▌ │
└─────────────────────────────────────┘
```
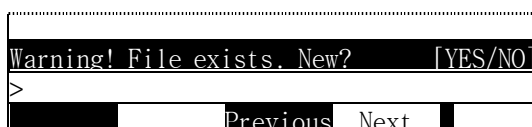
⑶ If the machine constant file(ROBOT.C01) exists and the attribution of file is set to the complete protection, the following message is displayed. And if pressing the [Esc] key, you can begin it again.

```
┌─────────────────────────────────────┐
│                                     │
│ Can't delete! Check file protection[ESC]│
│ >                                   │
│                 Previous  Next    ▌ │
└─────────────────────────────────────┘
```
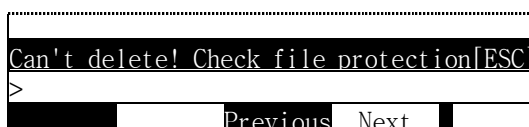
⑷ If the error history file(ROBOT.E01), stop history file(ROBOT.S01) and operation history file(ROBOT.TR0) exist, the following message is displayed. And if pressing the [Yes] key, it is newly made out and conversely, if pressing the [No] key, it is cancelled.

```
..........................................................
Error log file already exists! New?[Y/N]
>
█████████      Previous  Next  █
```

```
..........................................................
Stop log file already exists! New? [Y/N]
>
█████████      Previous  Next  █
```

```
..........................................................
Operation history file exists! New?[Y/N]
>
█████████      Previous  Next  █
```

⑸ If the error history file(ROBOT.E01), stop history file(ROBOT.S01) and operation history file(ROBOT.TR0) exist and the attribution of file is set to the complete protection, the following message is displayed. And if pressing the [Esc] key, you can begin it again.

```
..........................................................
Can't delete! Check file protection[ESC]
>
█████████      Previous  Next  █
```

⑹ The file protection can be changed in "SERVICE"[PF1] → 5.File control → 7.Protection .

6.5.4 Use setting

Outline

It is a function that sets the work use.

In case of using the palletizing function and the robot equalizing function, certainly, the use setting should be changed.

Screen display

```
14:39:38  *** Usage setting ***  A:0 S:4
 GUN 1 = [ 0]         GUN 2 = [ 0]
     0:Spot,1:Stud,2:Non,3:Palleting
 Application _____
    ARC      = <DSBL,ENBL>
    Air-GUN1 = <EQ,EQ'less>
    Air-GUN2 = <EQ,EQ'less>


 Enter number and press [SET]
 >[0 - 2]
```

Contents of the screen

■ GUN1 : The users select the item that they intend to use for the use of GUN1.

■ GUN2 : The users select the item that they intend to use for the use of GUN2.

■ ARC : If the robot is used for the arc welding, it is set to the <Enable>.

■ Air gun : It selects whether to use the equalizer function on the GUN1 and GUN2 or to use the equalizerless function.

Reference

⑴ If the engineer code isn't inputted, even if the "Complete"[PF5] key is pressed, the GUN mode conversion information isn't saved.

6.5.5 Positioner group setting

Outline

It is a process that registers the positioner manipulator and it can set the additional
axis which is set to the Jig axis in the initialization menu to the positoner group.
The controller of our company supports the positioner of only two unit at present. and
the assignment of two axis per each positioner is possible.

Please refer to the "User manual on the positioner synchronous function" for the
precise contents.

Screen display

```
14:39:38 ** Positioner Group ** A:0 S:4

Additional Axis      Positioner Group
---------------      ---------------
   T1 Axis               [0]
   T2 Axis               [0]
   T3 Axis               [0]



Enter number and press [SET]
>[0 - 2]

```

Reference

(1) Positioner group setting method

    Example1) In case of setting the 2 axis positioner and the 1 axis positioner
          (It is corresponded in case that all the additional 3 axes are set to the JIG.)

```
Additional Axis       Positioner Group
---------------       ---------------
 T1 Axis  ------------> [1]
 T2 Axis  ------------> [1]
 T3 Axis  ------------> [2]
```

    It is the case that the T1 and T2 axis make the first positiner group in the group
    1 and the T3 axis singly makes the second positioner group.

Example2) In case of setting the 1 axis positioner and the 2 axis positioner
(It is corresponded in case that all the additional 3 axes are set to the JIG.)

```
Additional Axis        Positioner Group
---------------        ----------------
 T1 Axis  ------------> [1]
 T2 Axis  ------------> [2]
 T3 Axis  ------------> [2]
```

It is the case that the T1 axis singly makes the first group of positioner in the
group 1 and makes the positioner 2 group by collating with T2 and T3.

Example3) In case that the 1 axis positioner exists two unit.

```
Additional Axis        Positioner Group
---------------        ----------------
 T1 Axis  ------------> [1]
 T2 Axis  ------------> [1]
 T3 Axis  ------------> [0]
```

It is the case that the T1 axis makes the positioner 1 group and the T2 axis makes the
positioner 2 group.

Example4) In case of setting to the Jig axis that doesn't synchronize.

```
Additional Axis        Positioner Group
---------------        ----------------
 T1 Axis  ------------> [0]
 T2 Axis  ------------> [0]
 T3 Axis  ------------> [0]
```

It is the case that uses the basic value.

(2) The method that designates the positioner group.

① The designation of group should be carried out according to the order from low axis.
② The group that doesn't synchronize is designated to [0] and should be set next
   to the axis that synchronizes.
③ You should not designate the 3 axis to the same group because the same group of
   positioner supports only till the 2 axis.
④ You should press the "Complete"[PF5] key to finish the group setting right.
⑤ In case of defining the group setting again, you should execute the calibration
   of positioner again because the constant value of positioner designated in the
   former times is ineffective.

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6.6 Automatic constant setting

If selecting the constant setting, the following screen is displayed.

```
14:39:38 *** Auto Const Set *** A:0 S:4
 1: Optimizing axis Cnst.& tool length
 4: Positioner Calibration




Use [Number]/[Up][Down] and press [SET].
>
         Previous   Next
```
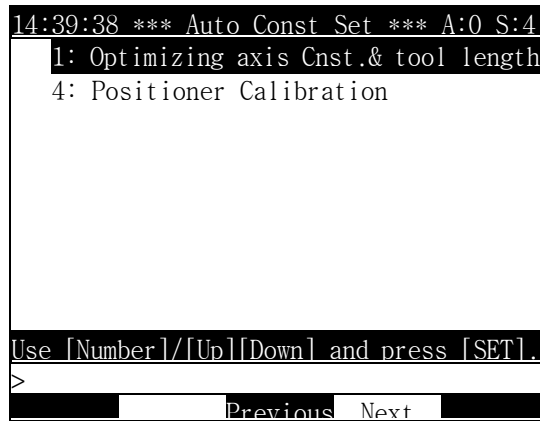
6.6.1 The optimization of axis constant and tool length

Outline

It sets automatically after compensating the constant data of straight line interpolation.

It is a function that gains the straight line interpolation constant compensated from each step encoder data of the program recorded the same point as the various pose to improve the accuracy of the straight line interpolation curve and coordinate convertion.

It can automatically set the distance till the nose of tool which is difficult to measure on the three dimensions. the straight line interpolation constants which are compensated are the axis constant of H, V, R2, B axis and the tool length of X, Y, Z direction.

Screen display

```
14:39:38** Axis/Tool optimize **A:0 S:4


Setting = < Constant & Tool, Tool >
Program No.              = [  0]
Tool NO.                 = [  0]
Permissible position error = [ 0.1]mm



Max step position error(X) =
                      (Y) =
                      (Z) =
Press [SHIFT]+[<-][->] Key.
>

```

Screen description

■ Setting : If using the "constant and tool" mode, both the tool length set in "SYSTEM"[PF2] → 3.Robot parameter → 1.Tool data and the value set in "SYSTEM[PF2] → 3.Robot parameter → 2.Axis constant are compensated.
Therefore this mode is selected only in case of executing the function on the first tool and from the second tool, please compensate only the tool length through the selection of tool mode.

■ Program number : It is a program number recorded the same point as the various pose.

■ Tool number : It is a tool number that wants to set automatically and it should accord with the tool number recorded in the program for setting.

■ Permissible range of step position error : When the maximum errors among the coordinates is within the permissible error of step position error after calculating the X, Y, Z coordinates of the nose of tool from the each step data of program for the setting by using the constant data which is compensated, it renews the constant data automatically.

■ Maximum step position error : It outputs the maximum value of the error among the X, Y, Z coordinates on the each step found in the permissible range of step position error.

Notice

⑴ Please teach it as the error between the tool end and the fixed point is within 0.5mm.

⑵ Please teach it as all of the axes work.

⑶ Please teach it as the angle of B axis exists in the outside of the range that is from −12 to 12 .

⑷ Please teach it as the wrist axis(R2, B, R1) on the each step works as big as possible and the difference of wrist axis angle among each step is sufficient.

⑸ It can't be executed in case that the machine constant file is protected. Please execute it after lifting the file protection.

6.6.4 Positioner calibration

Outline

Please refer to the "User manual on the positioner synchronous function".

If not carrying out the "SYSTEM"[PF2] → 5.Initialization → 6.Positioner group setting but selecting the positioner calibration, the following message is displayed.

```
You must setup the positioner Group[ESC]
>
             Previous  Next
```

Screen display

```
14:39:38*Positioner Calibration*A:0 S:4

Positioner Group No.      = [   0]
Program No.               = [   0]




Select and Enter number. Press [SET].
>[1 - 1]
```

■ If pressing the "Execute"[PF5] key after inputting the program number on the applicable positioner group, the result appears.

Reference

⑴ The calibration of 1 axis positioner

① In case of the 1 axis positioner, it teaches the three points precisely rotating 30   per one time after fixing the sharp teaching point on the positioner and then records the program. The teaching method is the same as following picture.
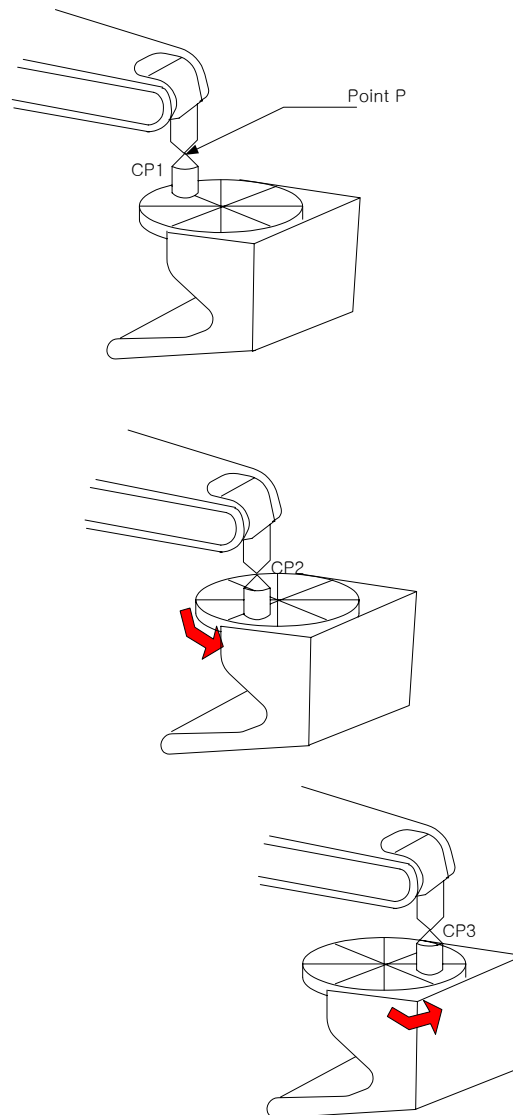
The calibration of 1 axis positioner

(2) The calibration of 2 axis positioner

  Supposing that it is identical with the calibration of 1 axis positioner, it is
  different from in the record of the teaching point.

  ① It records the very first teaching point after situating the positioner at the basic
  position.
  ② It records the same teaching point after rotating the 2 axis of positioner nearly
  30.
  ③ It records the same teaching point after rotating the 2 axis of positioner nearly
  30 more.
  ④ It records the fourth point after rotating only the 1 axis at the position of ③
  nearly 30.

⑤ It records the fifth point after rotating only the 1 axis at the position of ④ nearly 30 more and then finishes.
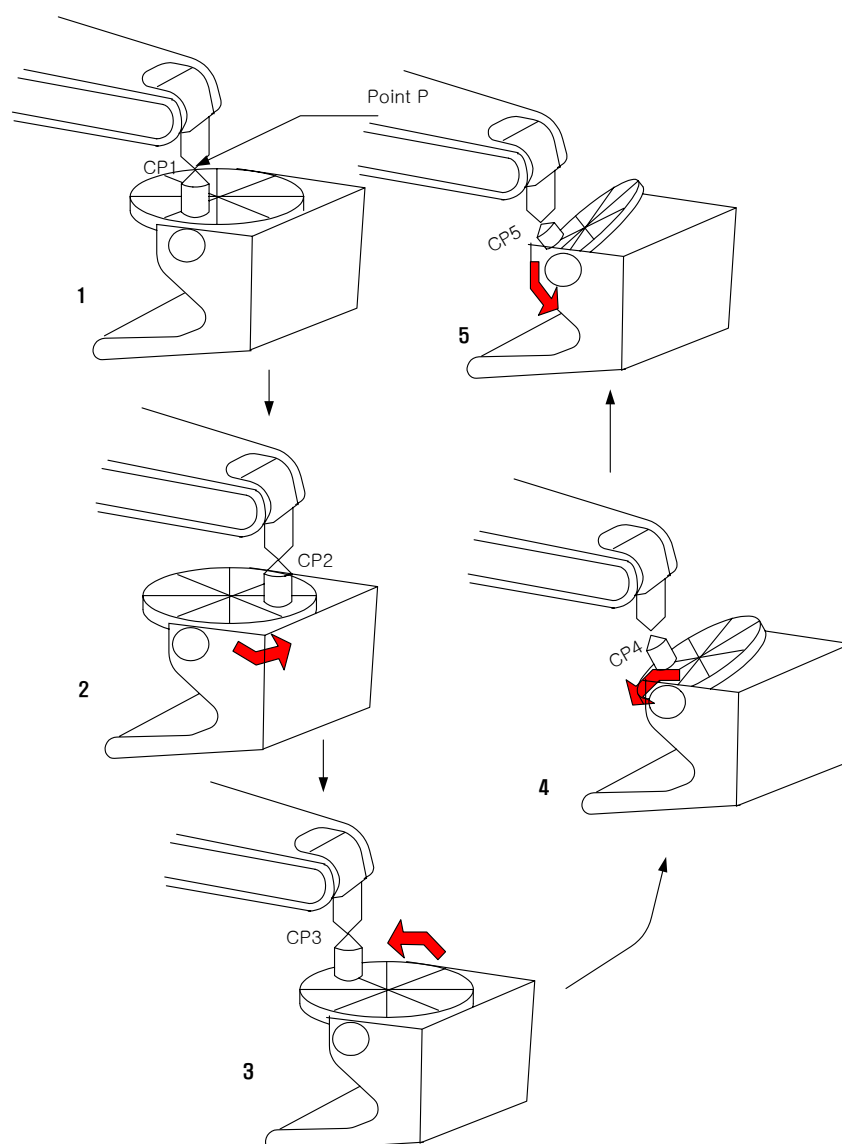
The calibration teaching process of 2 axis positioner

■ If pressing the execution key after selecting the "SYSTEM"[PF2] → 6. Automatic constant setting → 4.Positioner calibration and inputting the program number which teaches the fifth point and the applicable positioner group, the result is displayed and the constant is saved in the controller.

```
14:39:38*Positioner Calibration* A:0 S:4
 Positioner Group           = [   0]
 Program No.                = [   0]
Positioner Group [1] POSE
    X=       0, Rx=     -90.000
    Y=     500, Ry=       0.000
    Z=     300, Rz=      90.000
D-H Parameter
    DH.a=       0,  DH.alpha=       90
    DH.d=       0,  DH.theta=        0
Save?
>
```

■ If pressing the "Execute"[PF5] key, the message of upside is displayed. and at this time, if you want to save it, press the [Yes] key.

   Contents of the screen

   ■ Positioner Group [1] Pose : It is the position value from the base coordinates to that of the positioner. The value of Rx, Ry, Rz are the angle value calculated by the absolute conversion in the direction of each axis from the base coordinates.

   ■ D-H Parameter : In case of the 2 axis positioner, the value of DH .a and DH .alpha are calculated. The DH .a is the distance between two rotation axes and the DH .alpha is what indicates the angle between two rotation axes to the [deg].

Notice

(1) The tool end position of robot should be accurate. Therefore you should know of the tool information of robot precisely.

(2) The calibration of robot should be carried out before the positioner calibration.

(3) It can't be executed in case that the machine constant file is protected. Please execute it after lifting the file protection.

Chapter 7. R Code

Contents

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CHAPTER 7. R CODE

Outline

 It manages general programs without recording in steps. That is it can sets several conditions for controller state.

Operation method

⑴ If press R key, then the following message is displayed on the screen.

```
..................................................
Enter R code No (0 - 9999)
>R
Service  System Rel.WAIT        Cond.SET
```

⑵ Press wanted code number, and then press [SET] key.

⑶ If you don't know specific code number, press ? key. Then the following message is displayed on the screen.

```
14:39:38        *** Manual ***    A:0 S:H4
R0    : Step counter reset
R5    : External start selection
R6    : External program selection
R10   : Rum time display
R17   : Name of file in the memory
R18   : Frequency condition register
R29   : Tool number setting
R44   : Conveyor data clear
R45   : Conveyor register manual input
R46   : Manual conveyor limit switch on
R49   : Speed rate setting
------------------------------------------
R55   : Palletizing reset
R71   : Speed definition type selection
R107  : Program head data display
R115  : Program copy
R116  : Program renaming
R117  : Program deleting
R123  : Robot lock
R136  : Modifying accuracy in steps
R137  : Modifying MX in steps
R138  : Modifying GUN in steps
R162  : Shift register setting
Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```

▶ When you select, [NEXT] the following next message will be displayed on the screen.

```
14:39:38      *** Manual ***    A:0 S:H4
R163  : Online shift cancel
R204  : Spot WELDg Cond. manual output
R210  : Servo GUN number selection
R211  : Squeeze force setting
R212  : Moving-tip consumption preset
R213  : Fixed-tip consumption preset
R219  : Equalizerless gun No. selection
R220  : Equalizing tip consump. preset
R245  : Monitor mode selection
R269  : Memory protection setting
R286  : Software version
----------------------------------------
R320  : Set Max speed of setp go/back
R323  : Robot interrupt
R341  : Execution code backup



Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```

⑷ After choose what you want code, press [SET] key.

7.1　(1) R0 STEP COUNTER RESET

Outline

It resets the step counter (step 0) and returns to the step 0 at any step.
Besides, it executes.

- General error, Lamp Off
- Alarm Off
- WI wait clear.

Reference

⑴ It can't be executed during operation.

7.2 (2) R5 EXTERNAL START SELECTION (ENABLE/DISABLE)

Outline

It sets whether the external start selection is enable or disable.
It also can be set at start mode by press down "System'[PF2] -> 1. User parameter -> 3.
Robot Start type ,orderly.

Screen display

```
Set Ext start selection  (DSBL=0,ENBL=1)
>R5.0
Service  System Rel.WAIT        Cond Set
```

- Select 1 (= Enable) or 0 (= Disable), and then press [SET].

Reference

⑴ It cannot be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

7.3 (3) R6 EXTERNAL PROGRAM SELECTION (ENABLE/DISABLE)

Outline

It sets whether the external program selection setting is enable or disable.

It also can be set at Ext. Program selection mode by press down "System' [PF2] -> 1. User parameter -> 10. External program select, orderly.

Screen display

```
Set Ext program selection(DSBL=0,ENBL=1)
>R6.0
Service  System Rel.WAIT          Cond Set
```

■ Select 1 (= Enable) or 0 (= Disable), and then press [SET].

Reference

⑴ It cannot be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

7.4 (4) R10 RUN TIME DISPLAY

Outline

It is the function to display Robot's run time.
It also can be access at Run time display by press down "Service' [PF1] -> 7. System checking -> 2. Running time, orderly.

Screen display

```
14:39:38     *** Run time ***     A:0 S:4
       1: Display of run time
       2: Display of total run tiem
       3:      ( Clear all data    )
       4:      ( Clear run time    )
       5:      ( Clear cycle count )
       6:      ( Clear gun data    )
       7:      ( Clear I wait data )
       8:      ( Clear Timer wait data )

Use [Number]/[Up][Down] and press [SET].
>
              Previous  Next
```

7.4.1 Display of Run Time

Outline

It displays run time of robot motion.

Screen display

```
14:39:38     *** Run time ***     A:0 S:4
*Run time =0:0: 0.00
Cycle time=0:0: 0.00        Cycle=0
GUN1 time =0:0: 0.00        count=0
GUN2 time =0:0: 0.00        count=0
GUN3 time =0:0: 0.00        count=0
GUN4 time =0:0: 0.00        count=0
DI Sig waiting time =0:0: 0.00
Timer waiting time  =0:0: 0.00

Press [ESC] or [R..]
>
```

Screen description

■ Run Time means the time till the lamp is off after the start lamp is ON. (It resets automatically after 24 hours.)

■ Cycle Counter means the cycle number playback during run time.
   It counts in step 1, it counts the cycle number in spite of stopping in half way. (It
   resets the counter after 255 times during run time.)

■ GUN ON Time means the GUN signal output signal per 1 cycle during run time.
    (It resets automatically after 24 hours.)

■ GUN ON Count means the counts the GUN output signal per I cycle during run time.   (It
   resets automatically after 65535 times.)

7.4.2 Total Run Time

   Outline

   Total amount of the operation time after power is ON.
   Total cycle count, Total GUN On time, Total Gun ON count are as above too.

   Screen display

```
14:39:38    *** Run time ***    A:0 S:4
*Total run time   =0:0: 0.00
Total cycle count =0
GUN1 time =0:0: 0.00          count=0
GUN2 time =0:0: 0.00          count=0
GUN3 time =0:0: 0.00          count=0
GUN4 time =0:0: 0.00          count=0
DI Sig waiting time =0:0: 0.00
Timer waiting time  =0:0: 0.00


Press [ESC] or [R..]
>
```


7.4.3 Run Time Reset

   Outline
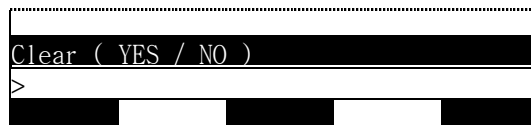
   (1) All data clear ..... It resets the all data.

   (2) Run time clear ..... Reset the total run time.

---

 (3) Cycle count clear ..... Reset the total cycle counter.

 (4) GUN data clear ..... Reset total GUN on time and counter.

 Screen display

 After selecting "3" for All Data Clear or "4" for Run Time Clear, "5" for Cycle Count Clear, "6" for Gun Data Clear. "7" for I Signal Waiting Data Clear, "8" for Timer Waiting Data Clear , it will be displayed on the screen as followings.

```
┌─────────────────────────────┐
│                             │
│ Clear ( YES / NO )          │
│ >                           │
│                             │
└─────────────────────────────┘
```

■ If you select [YES] , the chosen data shall be cleared. Otherwise, If you select [NO] , the chosen data shall not be cleared.

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7.5 (5) R17 FILE NAME DISPLAY IN INTERNAL MEMORY

Outline

It displays the file name (Robot type, Program No.), file size, Date, file protection etc. It displays the information of a total file, remained memory volume when ending a file display. The content of the display is different from "Service[PF1] -> 5. File manager -> 1. Show file names in memory".

Screen display

```
14:39:38  *** M A N U A L ***  A:0 S:H4
TO
PN:999[*]__ S/F=3/1   Sp:20.00
 10 file, 62116 Block free
 H120    .992    33 2001-08-20 08:54 W_
 H120    .993    22 2001-08-20 08:54 __
 H120    .994    44 2001-08-20 08:54 __
 ROBOT   .C00   130 2001-08-20 08:54 w_
 ROBOT   .C01   196 2001-08-20 08:54 W_
 ROBOT   .E01  1111 2001-08-20 08:54 __
 ROBOT   .S01  1111 2001-08-20 08:54 __
 ROBOT   .TR0    59 2001-08-20 08:54 __
Use cursor Up/Down, then [ESC] for exit.
>
Service  System Rel WAIT        Cond Set
```

Reference

⑴ It cannot be executed during operation.

⑵ WSP_ being displayed to the last means the protection type.
   W: Whole protection (Deleting/changing prohibition)
   S: Sectional protection
      (It is possible only to modify the position in whole protection)
   P: Playback protection (Playback from the step 0/Step forward prohibition)
   _: No protection

⑶ It is possible to scroll the screen with ⬆⬇ key.

7.6 (6) R18 FREQUENCY CONDITION REGISTER DISPLAY/SETTING

Outline

It displays, sets the content of a frequency condition register.
It is the same as "Service"[PF1] -> 2: Register setting -> 5: Frequency Condition Register".

Screen display

```
Enter frequency register No ( 1 - 16 )
>R18.0
Service  System ReL.WAIT          Cond Set
```

Operation method

(1) After inputting the register No., if press [SET] key it will be displayed on the screen
    as following message.

```
Enter register data  ( 0 - 255 )
>R18.1.0
Service  System ReL.WAIT          Cond Set
```

(2) After inputting the register data, press [SET] key.

Reference

⑴ It can not be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

7.7 (7) R29 TOOL NUMBER SETTING

Outline

It changes the selected tool number.
Input tool number what you want, press [SET] key.

Screen display

```
┌─────────────────────────────────────┐
│                                     │
│Enter tool No. ( 0 - 3 )             │
│>R29.0                               │
│Service  System Rel.WAIT      Cond.Set│
└─────────────────────────────────────┘
```

Reference

⑴ When [SET] key pressed after inputted tool number, the first line of Edit Frame screen
    shall be changed.

⑵ It cannot be executed during operation.

⑶ The numerical value displayed before changing is the set value at that time.

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7.8 (8) R44 CONVEYOR DATA CLEAR

Outline

It clears Conveyor data ; CP, CR, CS.

The content which will be cleared can be different according to the selected mode at "Cond Set"[PF5] -> "Applicnd"[PF1] -> 1: Conveyor oper = <Normal, Simulat, Test> as table.

	General	Simulation	Test
CP(Pulse)	CLEAR	Keep present pulse	CLEAR
CR(Distance)	CLEAR	CLEAR	CLEAR
CS(Speed)	CLEAR	CLEAR	Always '0'

It is the same function with 2.Conveyor data reset of "Service"[PF1] -> 2.Register -> 6. Conveyor Data.

Screen display

```
.........................................................
Conveyor data clear. Continue?  [YES/NO]
>
Service  System Rel.WAIT          Cond Set
```

■ If you select [YES], the conveyor data shall be cleared.
  Otherwise, If you select [NO], this function shall be cancelled.

Reference

⑴ It cannot be executed during operation.

⑵ The limit switch input state will be cleared, too. So, to start pulse counting, it
   needs new limit switch input.

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7.9 (9) R45 CONVEYOR REGISTER MANUAL INPUT

Outline

It sets Conveyor Register (CR) value as a manual inputted value.

If this function activated, the Conveyor Pulse (CP) value shall be automatically modified in connection with Conveyor Register (CR) value.

It is the same function with CR viewed at 1. Conveyor Simulation Date Access of "Service"[PF1] -> 2.Register setting -> 6. Conveyor Data

Screen display

```
Warning!)Change Conveyor Register? [Y/N]
>
Service  System Rel.WAIT        Cond.Set
```

■ If you select [YES] , can input Conveyor Register value by manual, if you select [NO] , this function shall be cancelled.

```
Enter CR value. (-99999.9 - 99999.9 mm)
>R45.
Service  System Rel.WAIT        Cond.Set
```

■ To finish, press [SET] key following input number.

Reference

⑴ It cannot be executed during operation.

⑵ In case of the Limit switch is not activated, the CP/CR value shall not be increased, even if the manually inputted Conveyor Register(CR) value is not '0'.

_____

7.10 (10) R46 MANUAL CONVEYOR LIMIT SWITCH ON

Outline

It activates Pulse counting in force by inputting limit switch activation signals without relation of real performance of limit switch.

Screen display

```
........................................................
Warning!) Limit Switch ON?        [YES/NO]
>
Service  System Rel.WAIT          Cond Set
```

■ If you select [YES], can start pulse counting or access for multi-workpiece , if you select [NO], this function shall be cancelled.

Reference

⑴ It cannot be executed during operation.

_____

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7.11 (11) R49 SPEED VARIATION SETTING

Outline

It sets the value of speed variation during the play back.
It playback to variate in the range of 1 to 150% for the speed to be recorded on step.

You can set in the speed variation value of condition Setting 4. at "Cond Set"[PF5] ->
4. Speed rate.

Screen display

```
Enter speed rate ( 1 - 150 )
>R49,100
Service  System Rel.WAIT          Cond Set
```

■ After inputting the speed variation value, if press [SET] key, it will be displayed
   on the screen as following message.

```
14:39:38    *** A U T O ***    A:0 S:H4
T0                         SR:100% 1Cycl
PN:999[*]__ S/F=3/1


>
Service  System Rel.WAIT          Cond Set
```

Reference

⑴ It cannot be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

7.12 (12) R55 PALLETIZE COUNTER RESET

Outline

It can be used when you use the palletizing function.
It resets the contents of the palletize register.

Screen display

```
Input the palletize pallet number.(1-16)
>[1 - 16]
Service  System Rel.WAIT        Cond Set
```

■ If press, wanted pallet No. (the number of palletizer pattern register) and [SET] key,
it will be displayed on the screen as followings.

```
End palletizing?                     [YES/NO]
>
Service  System Rel.WAIT        Cond Set
```

■ Press [YES] key to reset the palletizing data, and press [NO] to stop resetting.

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7.13 (13) R71 RECORDED SPEED SPECIFICATION METHOD SELECTION

Outline

It selects speed specification method in step recording.

There are 3 types of 0, 1, and 3.

0	Standard	Interpolation OFF	Specify Sec
		Interpolation ON	Specify Speed
1	Specify Sec	Interpolation OFF	Specify Sec
		Interpolation ON	Specify Sec
2	Specify Speed	Interpolation OFF	Specify Speed
		Interpolation ON	Specify Speed

Interpolation On is the case of the linear interpolation or circular interpolation.

Screen display

```
Rec speed type?(Standard=0,%=1,mm/s=2)
>R71,0
Service  System Rel.WAIT        Cond Set
```

■ After inputting the recorded speed specification type, if press [SET] key, it will
be displayed on the screen as following screen.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F=3/1        Sp:50




>
Service  System Rel.WAIT        Cond Set
```

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7.14 (14) R107 PROGRAM HEAD DATA DISPLAY

Outline

It displays the content of the program head data (step 0).
It displays the content of step 1 if it hasn't the function in step 0.

It is the same function with "Service"[PF1] -> 5.File Manager -> 2. Show the headline of program.

Screen display

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:100[*]__ S/F:4/0    Sp:100.00
PNo:  Content of head datat -----------
992:   main program
993:   SPOT 1
994:   25.00sec(P)  A0   T0
995:   25.00sec(P)  A0   T0

Use cursor Up/Down, then [ESC] for exit
>
Service  System Rel.WAIT        Cond Set
```

7.15 (15) R115 PROGRAM COPY

Outline

It copies a source program file in the internal memory to destination program file. First, input the source program number to be copied, and then input the destination program number. It occurs to error when the destination program is already exist.

Screen display

```
Source program to copy? (1-999)
>R115.
Service  System Rel.WAIT        Cond Set
```

■ After inputting the source program No. for copy, if press [SET] key, it will be appeared on the screen as following message.

```
Destination program to copy (1-999)
>R115.999.
Service  System Rel.WAIT        Cond Set
```

■ After inputting the destination program No. for copy, if press [SET] key, it will be copied. However if press [ESC] key program copy will be cancelled.

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7.16 (16) R116 PROGRAM NUMBER MODIFICATION

Outline

It changes the program number in the internal memory.
First, input the program number to change, then input the program number you want.

If occurs to error when the destination program is already exist.

Screen display

```
Source program to modify? (1-999)
>R116.
Service  System Rel.WAIT          Cond Set
```

■ After inputting the source program No. for modify, if press [SET] key, it will be
  appeared on the screen as following message.

```
Destination program to modify? (1-999)
>R116.999.
Service  System Rel.WAIT          Cond Set
```

■ After inputting the destination program No. for modify, if press [SET] key, it will
  be appeared on the screen as following message.

```
H120.999->.005     : Modify?         [YES/NO]
>
Service  System Rel.WAIT          Cond Set
```

■ If you want to modify press [YES] key, to cancel press [NO] key, it will be appeared
  on the screen as following message.

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7.17 (17) R117 PROGRAM DELETE

Outline

It deletes the program stored in the internal memory.

Screen display

```
Program to delete? (1-999)
>R117.
Service  System Rel.WAIT        Cond Set
```

■ After inputting the program No. for delete, if press [SET] key, it will be appeared
on the screen as following message.

```
H120.006  : Delete?              [YES/NO]
>
Service  System Rel.WAIT        Cond Set
```

■ If you want to modify press [YES] key, to cancel press [NO] key.

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7.18 (18) R123 ROBOT LOCK

Outline

It sets the robot lock to ON/OFF.

If the robot-lock is set to ON, it is possible to execute a program without outputting the move command even though playback or step go/back is executed in the motors-on state.

Screen display

```
Set_robot_lock_(_DSBL=0,ENBL=1)
>R123,0
Service  System Rel.WAIT        Cond.Set
```

■ If you press [1] [SET] key (Enable) it will be appeared on the screen as following message. or if you press [0] [SET] key(Disable) this function will be cancelled,

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0               R-L
PN:100[*]__ S/F:4/0    Sp:100.00
     Robot:H120, 6axes, 1steps
S1   MOVE P,S=100%,A=0,H=1


Use cursor Up/Down, then [ESC] for exit
>
Service  System Rel.WAIT        Cond.Set
```

7.19 (19) R136 MODIFY ACCURACY IN STEPS

Outline

It changes the accuracy of the selected step.

Screen display

```
Enter accuracy ( 0 - 3 )
>R136.0
Service  System Rel.WAIT          Cond Set
```

■ If press   0 ~ 3 key what you want, and then press [SET] to finish.

Reference

⑴ It cannot be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

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7.20 (20) R137 MODIFY MX IN STEP

Outline

It changes/adds MX of the currently selected step.

Screen display

```
Enter MX No ( 1 - 2 )
>R137,0
Service  System Rel.WAIT        Cond.Set
```

■ After inputting what you want key, if press [SET] key, it will be appeared on the screen
   as following message.

```
Set MX signal ( Off=0, On=1 )
>R137,1,0
Service  System Rel.WAIT        Cond.Set
```

■ If you select [1] and [SET] keys MX signal will be stored. Or if you select [0] and
   [SET] keys MX signal will be deleted.

Reference

⑴ It cannot be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

7.21 (21) R138 MODIFY GUN IN STEP

Outline

It changes/adds the GUN of the currently selected step.

Screen display

```
Enter gun No.( 1 - 2 )
>R138.0
Service  System Rel.WAIT        Cond Set
```

■ After inputting 1 or 2 key, if press S E T key it will be appeared on the screen as
  following message.

```
Set the gun signal (Off=0,On=1)
>R138,1,0
Service  System Rel.WAIT        Cond Set
```

■ If you select [1] and [SET] keys GUN signal will be stored in step. Or if you select
  [0] and [SET] keys GUN signal will be deleted.

Reference

⑴ It cannot be executed during operation.

⑵ The numerical value displayed before changing is the set value at that time.

7.22 (22) R162 SHIFT REGISTER VALUE CHANGE

Outline

It displays/sets the on-line shift buffer's contents.

It is the same function with "Service"[PF1] -> 2.Register setting-> 2. Shift buffers.

Screen display

```
14:39:38  *** M A N U A L ***  A:0 S:H4
1.Shift buffer for robot coordinate
 X=[     0.0]  Y=[    0.0]  Z=[    0.0]mm
AX=[   0.00] AY=[   0.00] AZ=[   0.00]dg
2.Shift buffer for tool coordinate
 X=[     0.0]  Y=[    0.0]  Z=[    0.0]mm
AX=[   0.00] AY=[   0.00] AZ=[   0.00]dg


Select and Enter number. Press [SET]
>[-3000.0 - 3000.0]
                                 Complete
```

Reference

⑴ It cannot be executed during operation.

⑵ After select number, press [SET] key.

7.23 (23) R163 ON-LINE SHIFT CANCEL

Outline

It stops on-line shift and resets the shift data saved in the shift buffers resets to "0".
Press [YES] or [NO] key by confirming message.

Screen display

```
WARNg) Cancel on-line shift       [YES/NO]
>
Service  System Rel.WAIT        Cond Set
```

■ If you want to cancel, press [YES] key.

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7.24 (24) R204 SPOT WELDING CONDITION MANUAL OUTPUT

Outline

It outputs spot welding condition manually.

Operation method

■ In case of < Welding condition output type = Discrete >, at "System"[PF2] -> 4.
Application Parameter -> Spot & Stud -> 1.Welding Parameter. It will be appeared on
the screen as following message.

```
Input discrete welding condition (0 - 7)
>R204.
Service  System Rel.WAIT        Cond Set
```

■ In case of < Welding condition output type = Binary code > at "System"[PF2] -> 4.
Application Parameter -> Spot & Stud -> 1.Welding Parameter. It will be appeared on
the screen as following message.

```
Input binary WELDg condition ( 0 - 255 )
>R204.
Service  System Rel.WAIT        Cond Set
```

■ After inputting the welding condition with numeric key, press [SET] key.

Reference

(1) It cannot be executed during operation.

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7.25 (25) R210 SERVO GUN NUMBER SELECTION

Outline

It is a code for selection of gun, in case of using multi-servo guns. It needs to execute manual open/close of servo gun and to force manually for each gun.

Screen display

```
Enter gun number.( 1 - 2 )
>R210,1
Service  System Rel.WAIT        Cond.Set
```

■ After select gun number, press [SET] key.

Reference

(1) It cannot be executed during playback / operation.

(2) Tool number will be automatically modified by selection of Gun number.

7.26 (26) R211 SQUEEZE FORCE SETTING

Outline

It sets welding force.

Screen display

```
Enter gun pressure. ( 50 - 999 )Kgf
>R211,100
Service  System Rel.WAIT        Cond.Set
```

■ After input wanted welding force, press [SET] key.

Reference

(1) It cannot be executed during playback / operation.
(2) The welding force in welding condition file, will not be changed.
(3) In case of the setting welding force is out of the available setting boundary, it executes manual welding force within the limited range.

7.27 (27) R212 MOVING-TIP CONSUMPTION PRESET

Outline

It sets wear amount of servo gun's moving welder tip.

Screen display

```
Enter move tip consumption.(-10. - 10.)
>R212.0.00
Service  System Rel.WAIT        Cond.Set
```

■ After input wanted wear amount with number keys, and then press [SET] key.

Reference

⑴ It cannot be executed during playback / operation.

⑵ In case of the setting wear amount is over the actual wear amount, it can cause
    mismatching of welding force or interference with working material.

7.28 (28) R213 FIXED-TIP CONSUMPTION PRESET

Outline

It sets wear amount of servo gun's fixed welder tip.

 Screen display

```
Enter fix tip consumption. (-10. - 10.)
>R213.0.00
Service  System Rel.WAIT        Cond.Set
```

■ After input wanted wear amount with number keys, and then press [SET] key.

Reference

⑴ It cannot be executed during playback / operation.

⑵ In case of the setting wear amount is over the actual wear amount, it can cause
    mismatching of welding force or interference with working material.

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7.29 (29) R219 EQUALIZERLESS GUN NUMBER SELECTION

Outline

It selects gun, in case of equalizerless multi-air guns are using.
It needs for manual open/close and forcing manually.

Screen display

```
..................................................
Enter gun number.( 1 - 2 )
>R219.1
Service  System Rel.WAIT        Cond.Set
```

■ After input wanted gun number, and then press [SET] key.

Reference

(1) It cannot be executed during playback / operation.

7.30 (30) R220 EQUALIZING WELDER TIP CONSUMPTION PRESET

Outline

It sets equalizerless air gun's wear amount manually.

Screen display

```
..................................................
Enter fix tip consumption. (-10. - 10.)
>R220.0.00
Service  System Rel.WAIT        Cond.Set
```

■ After input wanted wear amount with number keys, and then press [SET] key.

Reference

(1) It cannot be executed during playback / operation.

(2) In case of the setting wear amount is over the actual wear amount, it can cause
    mismatching of welding force or interference with working material.

7.31 (31) R245 MONITOR MODE SELECTION

Outline

  It displays the encoder value, angle and coordinates value of each axis and input/output status of each axis.

  It is the same function with "Service"[PF1] -> 1. Monitoring.

Screen display

```
14:39:38  ***  Monitoring ***   A:0 S:4
     0: Monitor OFF
     1: Axis data
     2: Private input
     3: Private output
     4: DIO(  1 - 24 )
     5: DIO( 25 - 48 )
     6: DIO( 49 - 72 )
     7: DIO( 73 - 96 )
     8: DIO( 97 - 120)
     9: DIO(121 - 144)
    10: DIO(145 - 168)
Use [Number]/[Up][Down] and press [SET].
>
   Line          Previous  Next
```

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7.32 (32) R269 MEMORY PROTECTION SETTING

Outline

It sets the program protection in the internal memory.

It is the same function with "Service"[PF1] -> 5. File Manager -> 7. Protect.

Operation method

```
Program to protect? (1-999)
>R269.
Service  System Rel.WAIT        Cond Set
```

■ After inputting the program No. for protect with a numeric key, press [SET] key, then
  it will be appeared on the screen as following messages.

```
Protect or Release?(1:Protect/2:Release)
>R269.6.
Service  System Rel.WAIT        Cond Set
```

■ If you want to protect press [1] key, to release press 2 key, and press [SET] key
  displayed following messages.

```
Protect type?(1:Whole/2:Section/3:Playb)
>R269.6.1.
Service  System Rel.WAIT        Cond Set
```

■ After inputting the protect type with a numeric key, press [SET] key.

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7.33 (33) R286 SOFTWARE VERSION DISPLAY

Outline

It displays the system environment (Software Version) of HR Controller.

The display items are as following
(1) Robot type, number of robot axis and total number of axis.
(2) Main system version
    - Version and the date of the manufacture of the main S/W
    - Version and the date of the manufacture of the motion S/W
    - Version and the date of the manufacture of T/P
    - Version and the date of the manufacture of I/O

It is the same function with "Service"[PF1] -> 7. System checking -> 1. System version.

Screen display

```
14:39:38 *** System version ***  A:0 S:4
Robot type: H120    (Axis: 6 Tot Ax: 6)
Main system Version => Robot Language
      Main S/W: V07.01-02  2001-06-18
    Motion S/W: V07.00     2001-07-09
     T/P Ver : V01.03      1999-05-31
     I/O Ver : V01.00      1997-04-09
DSP Version
     DSP1 S/W: V02.71      2000-03-20
     DSP2 S/W: V04.33      1993-03-29
     DSP3 S/W: V00.00       0-00-00
     DSP4 S/W: V00.00       0-00-00
Press [ESC] or [R..]
>
              Previous  Next
```

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7.34 (34) R310 MANUAL OUTPUT OF GO-SIGNAL

Outline

It outputs 8 signals as 1 group at the same time.

Operation method

```
Enter Group number ( 1 - 32 )
>R310,10
Service  System Rel.WAIT          Cond Set
```

■ After inputting the group No. with a numeric key, if press [SET] Key, it will be appeared
on the screen as followings.

```
Input data to be output manually (0-255)
>R310,10,255
Service  System Rel.WAIT          Cond Set
```

■ After inputting the data with a numeric key, press [SET] key.

Reference

⑴ It can not be executed during operation.

⑵ The displayed value before changing the numerical value displays the current setting
status.

7.35 (35) R320 SET MAX. SPEED OF STEP GO/BACK

Outline

 It sets the Max. speed when the step go/back in teach mode.
 It is possible to change from the speed when the step go/back in the range of 1 to 250㎜/s
without the received speed.

 Also, it is possible to set at "Condition Setting"[PF5] -> 2.Step Go/Back Max. Speed.

Screen display

```
Step GO/BACK speed?  (1 - 255mm/s)
>R320,200
Service  System Rel.WAIT        Cond.Set
```

■ After inputting the speed ratio with a numeric key, press [SET] key.

Reference

⑴ It cannot be executed during operation.

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7.36 (36) R323 ROBOT INTERRUPT FUNCTION RECORD

Outline

While moving to target step, it skip to next step as interruption function by detecting assigned signals.

Screen display

```
........................................................
0:DI Sig,1:Analog,2:Weld sticking(0 - 1)
>R323,
Service  System Rel.WAIT          Cond Set
```

■ Choose [0] for I-signal or [1] for Analog, [2] for Weld sticking is not available now.

7.36.1 0 : I-signal

Outline

While moving to target step, it skip to next step as interruption function by detecting assigned I-signal (input signal) input. (That is, treat as if reached at target step) For example, if there is a recorded function at Step2 and fulfilled assigned condition while performing Step 3, it moves to Step 4 from the point of Step 3.

Operation method

After inputting [0], if press [SET] key, it will be appeared on the screen as followings.

```
........................................................
Enter Input signal ( 1 - 240 )
>M29=
Service  System Rel.WAIT          Cond Set
```

■ After inputting the No. of I-signal with a numeric key, if press [SET] key, it will be appeared on the screen as followings.

```
........................................................
Set "reference point setting" (0 - 1)
>M29=5,
Service  System Rel.WAIT          Cond Set
```

■ If you choose [0] for reference point setting, other parameters (reference X, reference Y, reference Z) will be 0 automatically, and complete input. If you choose [1] for reference point setting, there will be a message as followings using search function.

```
Enter reference X (-3000.0 - 3000.0)
>M29=5,1,
Service  System Rel.WAIT      Cond Set
```

■ After inputting the No. of X-point with a numeric key, if press [SET] key, it will be appeared on the screen as followings.

```
Enter reference Y (-3000.0 - 3000.0)
>M29=5,1,200.0,
Service  System Rel.WAIT      Cond Set
```

■ After inputting the No. of Y-point with a numeric key, if press [SET] key, it will be appeared on the screen as followings.

```
Enter reference Z (-3000.0 - 3000.0)
>M29=5,1,200.0,150.0,
Service  System Rel.WAIT      Cond Set
```

■ After inputting the No. of Z-point with a numeric key, if press [SET] key, it will be appeared on the screen as followings.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
TO G1
PN:100[*]__ S/F=4/0     Sp:100.00
     Robot:H120, 6 axes, 1steps
S1   MOVE P,S=100%,A=0,H=1
     M29,I5,1,200.0,150.0,100.0
>
Service  System Rel.WAIT      Cond Set
```

7.36.2 1: Analog

Outline

In case of working material is access within the range of assigned voltage by detection of analogue sensor which is attached at robot or other place, if [1] for Analog selected, it performs next step after completion of robot moving.

Example
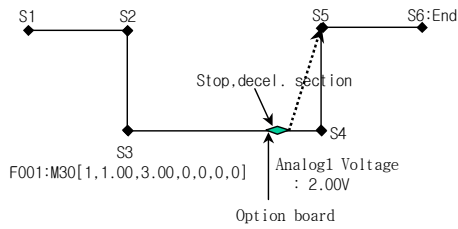
Operation method

After inputting [1], if press [SET] key, it will be appeared on the screen as followings

```
Enter port No ( 1 - 2 )
>M30=
Service  System Rel.WAIT        Cond Set
```

■ After inputting Port No. if press [SET] key, it will be appeared on the screen as followings

```
Input minimum voltage. (-10.0 - 10.0)
>M30,1,
Service  System Rel.WAIT        Cond Set
```

■ After inputting the No. of Lower voltage with a numeric key, if press [SET] key, it will be appeared on the screen as followings.

```
Input maximum voltage.(-10.0 - 10.0)
>M30=1,-5.00,
Service  System Rel.WAIT        Cond Set
```

■ After inputting the No. of Upper voltage with a numeric key, if press [SET] key, it will be appeared on the screen as followings.

```
Set "reference point setting" (0 - 1)
>M30=1,-5.00,5.00,
Service  System Rel.WAIT        Cond Set
```

■ If you choose [0] for reference point setting, other parameters (reference X, reference Y, reference Z) will be 0 automatically, and complete input. If you choose [1] for reference point setting, there will be a message as followings.

```
Enter reference X (-3000.0 - 3000.0)
>M30=1,-5.00,5.00,1,
Service  System Rel.WAIT         Cond.Set
```

■ After inputting the No. of reference X-value with a numeric key, if press [SET] key,
   it will be appeared on the screen as followings.

```
Enter reference Y (-3000.0 - 3000.0)
>M30=1,-5.00,5.00,1,200.0,
Service  System Rel.WAIT         Cond.Set
```

■ After inputting the No. of reference Y-value with a numeric key, if press [SET] key,
   it will be appeared on the screen as followings.

```
Enter reference Z (-3000.0 - 3000.0)
>M30=1,-5.00,5.00,1,200.0,150.0,
Service  System Rel.WAIT         Cond.Set
```

■ After inputting the No. of reference Z-value with a numeric key, if press [SET] key,
   it will be appeared on the screen as followings.

```
14:39:38  *** M A N U A L *** A:0 S:H4
TO G1
PN:100[*]__ S/F=4/0    Sp:100.00
     Robot:H120, 6axes, 1 steps
S1    MOVE P,S=100%,A=0,H=1
      M30,1,-5.00,5.00,1,200.0,150.0,100>

>
Service  System Rel.WAIT         Cond.Set
```

Reference

(1) It can not be executed during operation.

_____

7.37 (37) R341 EXECUTION CODE BACK-UP

Outline

It backups execution codes which are recorded at flash memory of board BD411 through PCMCIA slot with Linear Flash Memory Card.

Screen display

```
Backup execution code of controller?[Y/N]
>
Service  System  Rel.WAIT        Cond Set
```

■ If you select [YES], the back up function will be activated or if you select [NO], it will be canceled.

Reference

(1) It can not be executed during operation

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Chapter 8. Programming

Contents

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Chapter 8. PROGRAMMING

Outline

Program can be divided into 2 parts, Step and Function.

There are two way of recording Step
   1) Method of recording current position by pressing [RECORD] key.
   2) Method of selecting [MOVE] command at menu.
For 2) method, pose variables must be used as a factor.

To record function, both inputting by using PF keys and using keys of Teach Pendant are available.

Both Step and Function will be saved as a form of Command, and these Commands can be distinguished as a Command and Factor. Factor can be divided by Basic factor which is necessary basically and Selectable factor which can be different by situation.

If you add Command, default value shall be stored as a Basic factor and it can be changed. Selectable factors display as a form of '_', when the cursor moved over '_' mark, the range of factor shall be listed on the screen.

When edit factors of Command, inputted data shall be inserted at cursor. There are several methods to input. Direct input : by using Numeric keys, Selection input : inputting indexes which are listed in ( ) after selection variables and functions from menu, and Character input : inputting figures by using numerical formula or characters.
 Contents of current program can be listed at Edit frame, and it need to press [SET] after change. The [CANCEL] key means back to origin program in state of non-change.

To teach, please check the Teach mode is current mode or not, after press Power [ON] -> Motor [ON]. If it is not Teach mode, you can change by pressing [MODE] key.

8.1 EDIT STEP

It is a Command to move manipulator of robot, and most fundamental Command.

The position of the end of tool, speed, interpolation etc shall be assigned.

8.1.1 Record of Step

There are two methods to store (adding MOVE command) steps.

■ **Edition by using [MOVE] key.**

At Edit frame, if [REC] key pressed the MOVE statement shall be added at next line, no matter where the cursor located. In this case the location of step will be stored as current position in a style of hidden pose(the factor which indicating position will not be shown).

For factors such as speed, accuracy, interpolation, the listed data on the current screen of teach pendant will be selected basically, and it can be changed with proper factor.

The mode shall be changed to Edit mode in real time with recording.

Speed will be displayed at the right upper corner of frame.

Interpolation can be identified by the light of LED located under the [PF5] key.

■ **Edition by using Command input from Menu**

For adding steps, pose variables must be used with this method. For others . same as using [MOVE] key.

8.1.2 Modification of Step

■ For step which is recorded by record key
- To modify position only, press [Enable], [Pos. Modify] keys.
- To modify others, change factors after press [Command Modify] key.

■ For [Command Input] PF keys used. - using pose variables.
- To modify position only, press [Enable], [Pos. Modify] keys.
- To modify others, change factors after press [Command Modify] key.

■ For modification position only

Press [Enable]+[Pos.Modify] keys at the same time while the cursor located on MOVE.

Then the hidden pose of that step will be changed as a current position of robot.

8.1.3 Delete of Step

Press [Enable]+[Delete] keys at the same time while the cursor located on the line for deletion.

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8.2 SUMMARY OF OPERATION KEYS

	Address Area	Command	
		Statement Cursor Status	Word Cursor Status
Command Modify	–	As word cursor status.	–
EN + Position Modify	Modify position of current selected step (hidden posemodify). For modify posevariables and other factorsuse Command edit key	Modify position of current selected step (hidden posemodify). For modify posevariables and other factorsuse Command edit key	–
Cancel	Menu frame will be changed to upper menu..	Menu frame will be changed to upper menu.	Menu frame will be changed to upper menu. In case of highest menu, change to cursor mode. Cancel input value of input frame
Record Move	Adding hidden pose MOVE command	Adding hidden pose MOVE command	Adding hidden pose MOVE command
EN+Delete	Delete whole command	Delete whole command	Selectable factor:Delete Able Basic factor:Delete Disable
SET	Placing the inputted line No. at input frame to the cursor of address location	–	Placing the inputted factor value at input frame to the location word cursor
Speed Modify	Converse with word cursor mode to modify speed factor in the current line of Move command	Converse with word cursor mode to modify speed factor in the current line of Move command	Converse with word cursor mode to modify speed factor in the current line of Move command
WEAVON / Signal output	Add M-signal output Add WEAVON command	Add M-signal output Add WEAVON Command	Add M-signal output Add WEAVON command
WEAVOF / Wait	Add WAIT command Add WEAVOF command	Add WAIT command Add WEAVOF command	Add WAIT command Add WEAVOF command
Function / DELAY	Display Function menu on menu frame Add DELAY command	Display Function menu on menu frame Add DELAY command	Display Function menu on menu frame Add DELAY command
PF2 (Start Status)	[BLOCK EDIT] Display block edit menu.	[BLOCK EDIT] Display main menu	Display different menu according to command and factor
Command Menu (PF1~PF5)	Not display	Selected command will be inputted at under the current cursor in a shape of default Parameter	Display when the word cursor is located at command. Change current commandwith another command.
Block Edit Menu (PF1~PF5)	Execute by block edit menu (Selection, Copy, Delete, Add, End)	Not display	Not display

_____

Factor menu (PF1~PF5)	Not display	Not display	Input/Modify of factor command.
↑ ↓	Move cursor upward and downward	Move cursor upward and downward	Move menu frame upward and downward. In case of there is no '+'mark on far right end, it moves to word cursor up/down
←	Move cursor to Command area	Move cursor to Address area	Move word cursor to left factor
→	Move cursor to Command area	Move cursor to Address area	Move word cursor to right factor.
EN+↑ ↓	Page Up/Down	Page Up/Down	–
EN+← →	–	–	Move cursor to left/right in input frame. In case of Word input status, move cursor left/Right per 3 words.
BS	(After press EN + Command modify) At start : Delete address of Input frame While input : Delete numberleft side of cursor	–	At start : Delete contents of Input frame While input : Delete left side word of cursor
EN+P|STEP	Loading program which is selected	Loading program which is selected	–
P|STEP	Move to selected step by input of step number	Move to selected step by input of step number	–
HELP	Display help menu for each status	Display help menu for each status	Display help menu for each status
QuickOpen	Contents or condition screen display for each status.	Contents or condition screen display for each status.	Contents or condition screen display for each status.

_____

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8.3 EDIT COMMAND

8.3.1 Edition Screen

■ Address Area

It means the area which displays line number (1~9999) and step number(S1~S999).

```
14:39:38  ***  M A N U A L *** A:0 S:H4
T0
PN:100[*]__  S/F:4/1  Sp:100.00
S1    MOVE P,S=100%,A=0,H=1
S2    MOVE P,S=30cm/min,A=0,H=1
      WEAVON WEV#=1
      ARCON ASF#=1
S3    MOVE L,S=30cm/min,A=0,H=1
      ARCOF AEF#=1
      WEAVOF
S4    MOVE P,S=30cm/min,A=0,H=1
      END
Select PF menu
>S3
Service Blk.Edit Rel.WAIT      Cond Set
```

■ Command Area

It means the area which displays commands.   When whole line of this area selected, that means Word cursor status.

```
14:39:38  ***  M A N U A L *** A:0 S:H4
T0
PNo:100[*]__  SNo/F:4/1    Spd:100.00
S1    MOVE P,S=100%,A=0,H=1
S2    MOVE P,S=30cm/min,A=0,H=1
      WEAVON WEV#=1
      ARCON ASF#=1
      MOVE L,S=30cm/min,A=0,H=1
      ARCOF AEF#=1
      WEAVOF
S4    MOVE P,S=30cm/min,A=0,H=1
      END
Select PF menu
>
Service  System Rel.WAIT      Cond Set
```

Transfer between address area and command area can be done by using [⇦][⇨] keys.

8.4 EXAMPLE - MOVE SENTENCE

Method of adding move sentence is as follows ;
If press [REC] key, new move sentence will be created or added with already set performed
factors.

Interpolation : The lighted value on LED indicates current basic interpolation value.
To change interpolation, press [INTERPOLATION] key.
Pose (Tool End Position) : Storing Robot manipulator's current posture.
Speed : The value on Edit frame or on right upper side of title frame indicates basic
         speed value.
Accuracy : The value on the title frame indicates basic accuracy value.
Tool : The value under the time display indicates selected tool.

```
          Accuracy                        Speed

14:39:38  *** M A N U A L *** A:0 S:H4
T0
PN:999[*]__ S/F:1/0  Sp:100.00
       Robot:H6    , 6axes, 2steps
S1    MOVE P,S=100mm/sec,A=0,H=0,_ UNTIL>
S2    MOVE L,S=100mm/sec,A=0,H=0



Select interpolation type
>P
   OFF      Linear Circular
```
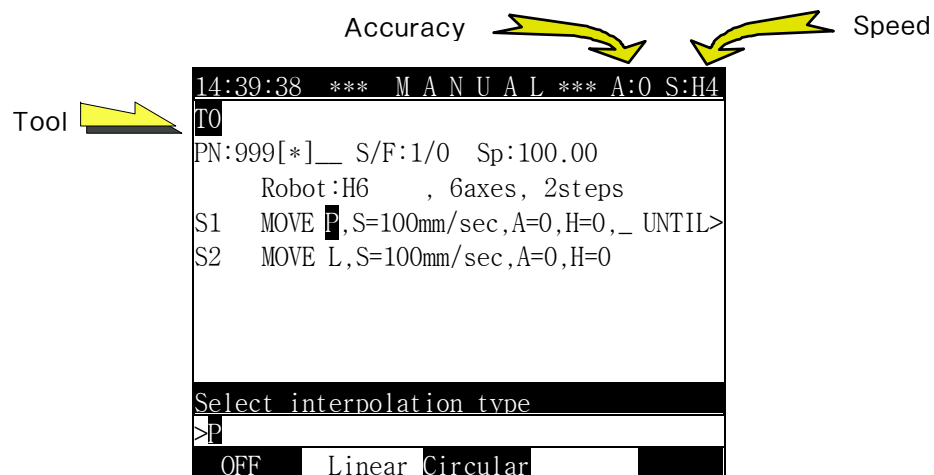
If press [RECORD] key, move sentence will be added and changed to word cursor status
simultaneously, under basis of basic value functions.

In case of there is not needed to change, just press down [SET] key.

   If you want to change factors, the procedure is same as edit with [Command Modify]
  as follows ;

   In case of adding MOVE sentence, first move cursor to the point of want. At that
  point press [Command Input] or [RECORD] key, then command sentence will be added in
  the line of the below of cursor point

< >: PF key , [ ] : T/P key , [CANCEL] : Upper menu. – Keys for user's operation

< Command Input > – Select inputting command

```
┌─────────────────────────────────────────┐
│                                         │
│ Select PF menu                          │
│ >                                       │
│ MOVE,I/O FlowCtrl  Etc.  ARC Weld Assign │
└─────────────────────────────────────────┘
```
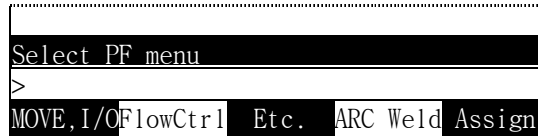
< MOVE,I/O > – Command related with Step(MOVE) and I/O

```
┌─────────────────────────────────────────┐
│                                         │
│ Select command                          │
│ >                                       │
│  MOVE   PRINT   INPUT  Sig.Out   WAIT    │
└─────────────────────────────────────────┘
```

< MOVE > – Add step

■ Inserting command under word cursor
   Automatically created basic factors as default value cannot deleted. Selective factor
  (use when needed and possible without it) displayed as '_' on the point of cursor.
  By command add, the cursor transfer from statement cursor status to word cursor status.
   After completion of command add, if it want to edit again, press [Command Modify]
  to transfer from statement cursor status to word cursor status.
   Press [SET] key to go back to statement cursor status, after edition.
   Press [ESC] key to go back to statement cursor status, without any change.

```
┌─────────────────────────────────────────┐
│14:39:38  ***  M A N U A L *** A:0 S:H4   │
│TO                                        │
│PN:999[*]__ S/F:1/0  Spd:100.00           │
│      Robot:H6    , 6axes, 2steps         │
│S1   MOVE P,P1,S=300mm/sec,A=0,H=0,_ UN>  │
│                                          │
│                                          │
│ Select interpolation type                │
│ >P                                       │
│  OFF    Linear  Circular                 │
└─────────────────────────────────────────┘
```
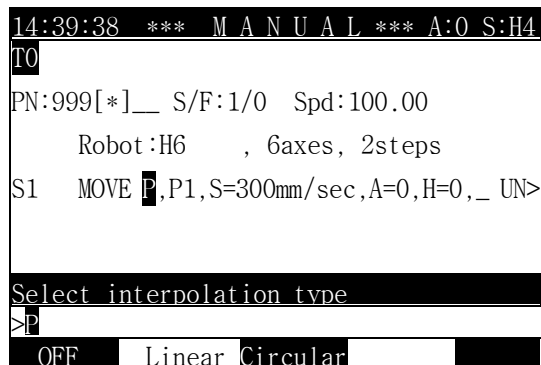
< Linear > [SET] [⇨] – Selection of Linear Interpolation.

To move cursor to the next factor, use cursor keys.

```
14:39:38 *** M A N U A L *** A:0 S:H4
T0
PN:999[*]__ S/F:1/0  Spd:100.00
     Robot:H6  , 6axes, 2steps
S1    MOVE L,P1,S=300mm/sec,A=0,H=0,_ UN>




Enter pose
>P1
   P        P[]        P*     P. Const Local
```

At word mode which is cursor indicating factor, current selected factor shown in input
frame as a form of reverse character. If press [BS] key, selected factor will be deleted.
If select menu, the reverse character part will be deleted and it changes to input
at start. It need to edit partly, select <Numerical Formula> for word units.

< P > - Selection of Pn among pose variables.

```
14:39:38  *** M A N U A L *** A:0 S:H4
T0
PN:999[*]__ S/F:1/0   Sp:100.00
     Robot:H6  , 6axes, 2steps
S1    MOVE L,P1,S=300mm/sec,A=0,H=0,_ UN>




Enter index(1-999)
>P
   +R       +R[]    Local Variable  Expr.+
```

[3] < +R[ ] > [2] [SET] - Select +R[ ] after number 1 input. And then input number 2

[SET]: There will be change in Edit screen by the change of content at input frame
[CANCEL]: Return to statement cursor mode without saving

※ If there are 5 more menus, at the end of final menu '＊' mark will be appeared.
By pressing [↑], [↓] keys, it displays as follows ;

```
14:39:38  *** M A N U A L *** A:0 S:H4
T0
PN:999[*]__ S/F:1/0   Sp:100.00
       Robot:H6  , 6axes, 2steps
S1    MOVE L,P3+R[2],S=300mm/sec,A=0,H=0>




Enter index(1-999)
>P3+R[2]
    +R      +R[]    Local Variable  Expr.+
```

[⇨] - Factor move

Select unit of velocity between [mm/sec], [sec], [%], [cm/min].

```
14:39:38  *** M A N U A L *** A:0 S:H4
T0
PN:999[*]__ S/F:1/0   Sp:100.00
       Robot:H6  , 6axes, 2steps
S1    MOVE L,P3+R[2],S=300mm/sec,A=0,H=0>




Enter speed ( 0.1-2300.0 )
>S(mm/sec)=300
   Unit    Conv        Variable
```

[1][2][0] [SET] [⇨] - Press [SET] key, after input speed 120. And then factor move follows.

※ If it want to change speed to 300.12, press [ENABLE] + [⇨] key. Then cursor locates at the end of numeric 300.

```
>S(mm/sec)=300_
```

At there input [.][1][2], it can be inserted.   If input [.][1][2] without pressing [ENABLE] + [⇨] key previously, just "0.12" shall be appeared as speed except 300.

Conversion can be used in changing units while maintaining current speed.
For instance, 300 mm/sec equals 1800 cm/min. To change unit and value in a same speed, press [CONVERSION] and select unit.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F:1/0   Sp:100.00
      Robot:H6 , 6axes, 2steps
S1   MOVE L,P3+R[2],S=120mm/sec,A=0,H=0>




Enter accuracy ( 0-3 )
>A=0
                          Variable  Expr.
```

[1] [SET] [⇨] [⇨] - Inputting accuracy. (H=0 ; Same method with Tool number
input) Move to MX.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F:1/0   Spd:100.00
      Robot:H6  , 6axes, 2stpes
S1   OVE L,P3+R[2],S=120mm/sec,A=1,H=0,




Adjust output option(Toggle)
>
     MX    MX2    G1    G2    BM
```

< MX > < G1 > [SET] - <MX>, <MX2>, <G1>, <G2>, <BM>. multi inputs
                     possible.

[CANCEL] - Transfer from word cursor mode to statement cursor mode.

[SET]   - Transfer to statement cursor mode.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PNo:999[*]__ SNo/F:1/0   Spd:100.00
      Robot:H6   , 6axes,  2steps
S1   MOVE L,P3+R[2],S=120mm/sec,A=1,H=0>




Select PF menu
>
MOVE.I/O FlowCtrl  Etc.  ARC Weld Assign
```

Input completed.

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※ To change contents in Edit frame with contents in Input frame, press [SET] key.
If press [SET] key one more time (that is, the contents of each frame are same), it
transfer from word cursor mode to statement cursor mode.
  If want to change one factor, press [Command Modify] , move to the factor and input
values. After that press [SET] key 2 times.   1st [SET] key executes converting inputted
data and 2nd [SET] means returning to previous state of [Command Modify] after complete
factor edition.

There are 3 forms of factor.

1. Arithmetic form
    Arithmetic variables(V%, V!, …), integral number, real number, arithmetic
    functions. In case of there is no arithmetical rules(+, -, *, /) it can be inputted
    with numerical keys and menu.

2. Sentence form
    Sentence form constant, sentence form variables, sentence form functions.
    To input, use menu for functions / variables and use [SENTENCE INPUT] after converse
     to statement input status menu for sentence form constant.

3. Pose form
   Pose constant, pose variables, shift etc.

For each form, several different factors can be used at the same time. For example,
in case of index of pose variable, Arithmetic form can be used because index treated as
a numerical formula(including constant).

For more detail, refer to Language Explanation chapter.

8.5 Variable, numerical formula and string edit

In case that variable, numerical formula and string edit is needed when editing an instruction statement, it can be selected in menu. Variable is input by menu method which is in case of unitary (one variable without operator, but a subscript can be used as a variable), numerical formula uses number and variable which includes operator, and it uses edit method by a character.

■ Variable

We take a speed input screen for an example.

```
┌─────────────────────────────────────────┐
│                                         │
│ Enter speed( 0.1-1100.0 )               │
│ >S(mm/sec)=120                          │
│  Unit    Conv         Variable  Expr.   │
└─────────────────────────────────────────┘
```

< Variable > - Entry into variable input state.

```
┌─────────────────────────────────────────┐
│                                         │
│ Enter variable                          │
│ >120                                    │
│   V      pose   shift    out       in   │
└─────────────────────────────────────────┘
```

< V > - Select variable.

```
┌─────────────────────────────────────────┐
│                                         │
│ Enter variable                          │
│ >120                                    │
│   V%      V!     V%[]    V![]            │
└─────────────────────────────────────────┘
```

< V%[ ] > - Select variable type to input.

```
┌─────────────────────────────────────────┐
│                                         │
│ Enter variable                          │
│ >V%[]                                   │
│   <       >        =     Variable  Expr.│
└─────────────────────────────────────────┘
```

If you select variable type that has subscript, cursor is located on subscript input position as inputting.

※ If you input it on the input frame, it as added just in front front of cursor.

< Variable > < V > < V% > - Select variable again by subscript.

```
┌─────────────────────────┐
│                         │
│ Enter variable          │
│ >V%[V%]                 │
│    <      >      =       │
└─────────────────────────┘
```


[2] [SET] - Numerical formula in the input frame becomes highlighted and input contents
are reflected in the edit frame.

```
┌─────────────────────────┐
│                         │
│ Enter variable          │
│ >V%[V2%]                │
│    <      >      =       │
└─────────────────────────┘
```


[SET]

Variable input completion. After changed value is reflected in the instruction statement,
it returns to the statement cursor again.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PNo:999[*]__ SNo/F:1/0     Spd:100.00
       Robot:H6        , 6axes,   2steps
S1     MOVE L,P3+R[2],S=V%[V2%]mm/sec,A=1>




Select PF menu
>
MOVE,I/O FlowCtrl  Etc.  Arc Weld Assign
```


■ Numerical formula

We take a speed input screen for an example. When the present speed is V1%mm/sec,
if it inputs the speed in numerical formula form

```
┌─────────────────────────┐
│                         │
│ Enter speed( 0.1-1100.0 )│
│ >S(mm/sec)=V1%          │
│   Unit    Conv    Variable  Expr.│
└─────────────────────────┘
```

< **Numerical formula** > - Entry into numerical formula input state.

```
┌────────────────────────────────────┐
│ " ` +-*/^=<>&|~(),[]%!$?{}:;`. @#W  │
│>V1%                                 │
│ Delete    <-      ->     space      │
└────────────────────────────────────┘
```
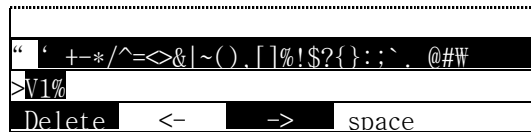
Present value is displayed in highlighted in the guide frame position. If you want
to ignore existing value and input newly, you can input it directly in number or input
character frame, and if you want to change it by using present value, press arrow of
PF2, PF3 and then the cursor will appear.
 ※ Press [SET] after selecting relevant character that is in input character frame.
PF2[<-], PF3[->] will make it move by one step, and if pressing with [ENABLE] will
make it move by 5 steps.

< -> > [ENABLE]+[⇨] < SET > [2]

```
┌────────────────────────────────────┐
│ " ` +-*/^=<>&|~(),[]%!$?{}:;`. @#W  │
│>S(mm/sec)=V1%/2                     │
│ Delete    <-      ->     space      │
└────────────────────────────────────┘
```
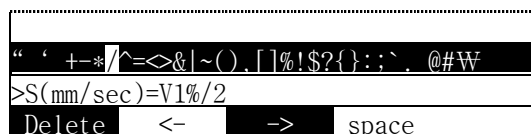
< **Completion** > - It returns to previous state (high position menu) which is not inputting
          numerical formula.

```
┌────────────────────────────────────┐
│ Enter speed( 0.1-1100.0 )          │
│>S(mm/sec)=V1%/2                     │
│ Unit    Conv      Variable  Expr.   │
└────────────────────────────────────┘
```
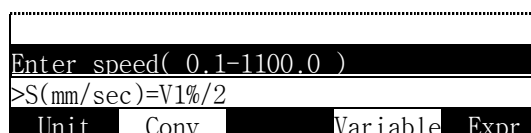
[SET] - It is reflected in the edit frame after completion of inputting by using numerical
          formula method.

[SET] - It changes instruction statement and then it returns to the statement cursor.

■ String

[Character input/8] If you press the key, it changes to the character input state and
          input method is the same as the numerical formula input.

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```
┌─────────────────────────────────────────────┐
│ " '    ABCDEFGHIJKLMNOPQRSTUVWXYZ            │
│ " '  _abcdefghkjklmnopqrstuvwxyz             │
│ " '  +-*/^=<>&|~(),[]%!$?{};;`._@#₩          │
│                                              │
│       ㄱㄲㄴㄷㄸㄹㅁㅂㅃㅅㅆㅇㅈㅉㅊ             │
│       ㅋㅌㅍㅎ +                              │
│                                              │
│       ㅏㅐㅑㅒㅓㅔㅕㅖㅗㅛㅜㅠㅡㅣ              │
│       +                                      │
│ >*Weld█                                      │
│ ▐Delete▌  <-   ▐ -> ▌  space                 │
└─────────────────────────────────────────────┘
```

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8.6 Line number edit

Step number is created at the same time when MOVE statement (step) is input. Line number is available within 1~9999 and the input method is that it is input line number in the address area.

At first, move a cursor to the address area,

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PNo:100[*]__ SNo/F:4/1    Spd:100.00
S1    MOVE P,S=100%,A=0,H=1
S2    MOVE P,S=30cm/min,A=0,H=1
      WEAVON WEV#=1
      ARCON ASF#=1
S3    MOVE L,S=30cm/min,A=0,H=1
      ARCOF AEF#=1
      WEAVOF
S4    MOVE P,S=30cm/min,A=0,H=1
      END
Select PF menu
>
Service Blk.EditRel.WAIT        Cond.Set
```

and then press [SET] after inputting line number.

[1] [0] [SET]

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:100[*]__ S/F:4/1    Sp:100.00
S1    MOVE P,S=100%,A=0,H=1
S2    MOVE P,S=30cm/min,A=0,H=1
  10  WEAVON WEV#=1
      ARCON ASF#=1
S3    MOVE L,S=30cm/min,A=0,H=1
      ARCOF AEF#=1
      WEAVOF
S4    MOVE P,S=30cm/min,A=0,H=1
      END
Select PF menu
>10
Service Blk.EditRel.WAIT        Cond.Set
```

Line number is reflected on the edit frame.

When a cursor is in address area in a instruction statement with line number, because the line number is highlighted in input frame, change is that inputting the line number like input, and input has the same method with change method, and in case of delection, the line number is deleted when you press [SET] after deleting by using a backspace[BS].

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8.7 Block edit

Is is a function that copying and moving to other place or deleting after copying whole lines of program. The control statement which includes step number has target step number's change automatically after copying. It is possible to edit by line at the address cursor mode. Step number is automatically changed.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F:0/2   Sp:100.00
      Robot:H6  , 6axes, 14steps
    1 V10!=0
      V11!=0
S1    MOVE L,P1+R[2],S=120mm/s,A=0,H=0
      *WELDING
   45 DELAY 1
      GOTO S2
S2    MOVE L S=100mm/sec,A=0,H=0
      END
Select PF menu
>
Service Blk.Edit Rel.WAIT        Cond Set
```

< block edit > [⇩] - Press block edit for copy/move/deletion by line.
        All of address, instruction areas are highlighted. You can move it to selection
        beginning line by using a cursor key.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F:0/2   Sp:100.00
      Robot:H6  , 6axes, 14steps
    1 V10!=0
      V11!=0
S1    MOVE L,P1+R[2],S=120mm/s,A=0,H=0
      *WELDING
   45 DELAY 1
      GOTO S2
S2    MOVE L S=100mm/sec,A=0,H=0
      END
Set start position of block region
>
 Select            Delete Close
```

< Selection > [⇩][⇩][⇩][⇩][⇩] - Press <Selection>key at the beginning line of block
to select. Move to last line of block to select by using a cursor key. Selected
area is displayed in highlighted as following picture.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F:0/2   Sp:100.00
     Robot:H6  , 6axes, 14steps
   1 V10!=0
     V11!=0
S1   MOVE L,P1+R[2],S=120mm/s,A=0,H=0
     *WELDING
  45 DELAY 1
     GOTO S2
S2   MOVE L S=100mm/sec,A=0,H=0
     END
Set end  position of block region
>
  Select            Delete  Close
```

< Selection > - At the end line of selection area, it ends selection of block area
by using a <Selection> key. The end line is flickering, so it is copied and moved
by using this line as a reference.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__ S/F:2/0   Sp:100.00
     Robot:H6  , 6axes, 14steps
   1 V10!=0
     V11!=0
S1   MOVE L,P1+R[2],S=120mm/s,A=0,H=0
     *WELDING
  45 DELAY 1
     GOTO S2
S2   MOVE L S=100mm/sec,A=0,H=0
     END
Select block edit function
>
Unselect  Copy   Move  Delete  Close
```

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[⇧] [⇧] - It moves to front line of the line where copied area will be pasted by using
a cursor key. (45 DELAY 1 line)

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__  S/F:1/2   Sp:100.00
     Robot:H6  , 6axes, 14steps
   1 V10!=0
     V11!=0
S1    MOVE L,P1+R[2],S=120mm/s,A=0,H=0
     *WELDING
  45 DELAY 1
     GOTO S2
S2    MOVE L S=100mm/sec,A=0,H=0
     END
Select block edit function
>
Unselect  Copy   Move  Delete  Close
```

<Copy> - Copied area is pasted just below a cursor.

```
14:39:38  *** M A N U A L ***  A:0 S:H4
T0
PN:999[*]__  S/F:1/3   Sp:100.00
     Robot:H6  , 6axes, 14steps
   1 V10!=0
     V11!=0
S1    MOVE L,P1+R[2],S=120mm/s,A=0,H=0
     *WELDING
  45 DELAY 1
     V11!=0
Selected region copied
>
Unselect  Copy   Move  Delete  Close
```

Label instruction can't be copied - Line number isn't also copied but only the instruction
statement can be copied.
The step number of the step to move is changed automatically.

If you press <End>, it returns to the initial screen.

Chapter 9. Quick Open Function

CONTENTS

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9.1 FUNCTION SUMMARY

OUTLINE

In case of teaching a work program of arc welding, it is required to set a detailed arc exclusive function such as weaving, Retry/Restart and welding machine's characteristic as well as welding relating condition such as voltage and current. And there's also several cases to need to check the step or auxiliary point's position basically. The conditions related with arc welding are managed as files inner controller, so there are needs to have functions to edit these condition files in easy and quick way. Because of these reasons, Quick Open function can be an answer that can check and change in controlling the key just once.

If taking a welding start condition for an example, if pressing [Quick Open] key(📝) when cursor is on the ARCON instruction statement which is used for Arc On, condition number's contents in welding start condition are displayed using in present instruction statement, and you can check and change the contents detailed in this screen. As well, if there is an other condition file related with present condition file, it's possible to move immediately. In other words, it is function that check and change the relating contents detailed such as condition file or step position which is related with specific instruction statement in easy and quick way.
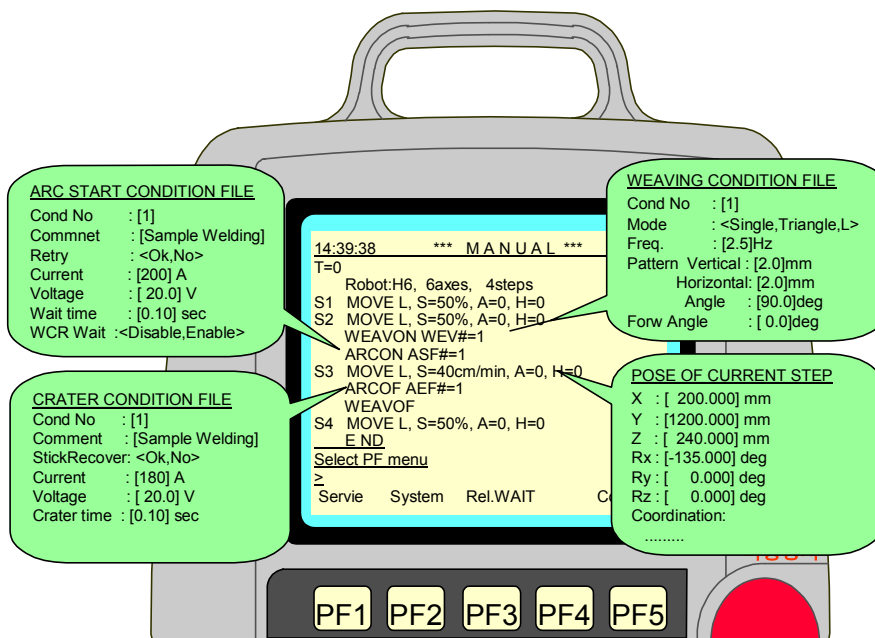
In a specific instruction statement, if you press [QuickOpen] key, the relating file or detailed contents are displayed. When it ends after saving, press "Complete"[PF5], when it ends without saving, press [Cancel].

In each instruction statement, when [QuickOpen] is pressed, the contents are as followings.

instruction statement	file, contents	detailed contents		remark
MOVE	Position	present position, ordered position*. X Y Z(mm) Rx Ry Rz(.) Robot Configuration		*can be edit
CALL JMPP	program called	imperative sentence display		

ASF#=	weld'g start con. file
	
	weld'g aux. con. file
	
	welding machine characteristic file
		welding start condition
		 Condition No., explanation, Voltage check, RETRY check, Action mode, Current, Voltage, WCR input wait check, wait (delay) time
		
		welding aux. condition
		 -RETRY: No. of times, RETRACT time, retract/welding line move amount, speed, Current, Voltage
		 -RESTART: No. of times, amount of superposition, Velocity, Current, Voltage, overlap condition setting
		
		welder characteristic
		 welder No., name, explanation, power, setting, diameter of wire, prominence length, wire stick detecting time, arc off detecting time.
		 -current characteristic
		  polarity, ordering value(V), measured value(A), compensation value.
		 -voltage characteristic
		  polarity, ordering value(V), measured value(V,%), compensation value		

AEF#=	welding end con. file weld'g aux. con. file welder char. file	weld'g end con. file condition No., Voltage check, explanation, Auto wire stick release, current, Voltage, condition holding time, gas holding time weld'g aux. condition file auto wire stick release: No. of times, current, voltage, delay time		
WEAVON WEV#=	weaving condition	weaving con. file condition No, weaving type, frequency, basic pattern, moving time, timer		
REFP	reference point	present position, ordering value. X Y Z(mm) Rx Ry Rz(.)	ordering value can be edit. same screen with " position" screen	
substitutional statement	variable check and change	It can monitor a relevant variable and change the value depending on the variable type of substitutial statement. V%, V!, V$, P, R, LV%, LV!, LV$, LP, LR		

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9.2 MOVE - step position

Outline

Press [✎](QuickOpen) key at move instruction.

Screen display

```
14:39:38 *** Step Pose Data *** A:0 S:4
 POSE OF CURRENT STEP
  X: [   840.000] mm
  Y: [   960.000] mm
  Z: [     0.000] mm
  Rx:[     0.000] deg
  Ry:[     0.000] deg
  Rz:[     0.000] deg
 Coordination : <Base,Robot,Encoder>
 Robot Configuration: <Define,Self-Cfg>
  <Front,Rear> <Up,Down> <Flip,Non-flip>
 Select and Enter number. Press [SET]
 >[-99999.999 - 99999.999]
                                    Save
```

screen contents

■ present step position
   (1) It displays relevant step position(pose).
   (2) When changing a step position, it is moved by using a cursor key, when it is edited,
       if [SET]key is pressed after inputing number, the contents input is reflected.

■ coordinate type : It selects the display type of present step position among Base
   coordinate system, Robot coordinate system and Encoder value.

■ robot config. type : It is displayed when the coordinate system form is Base or Robot
   coordinate system, and when the robot position is decribed, if you decribe the form
   uniquly, the selection of robot config. is needed because there are several values
   considering of its mechanism. In case of selecting the items, press [Shift(high
   speed)]+[<-] [->].

Edit method

Move the highlight bar on the item. In case of inputting the numerical value, if you
press [SET] key after inputting number on the input frame, the contents will be reflected.
In case of selecting one out of items in < >, if you press [Shift(high speed)]+[<-][->],
the highlight bar is moving and then it is immediately reflected. If you want to reflect
it to program, you finish it by pressing " record" [PF5]. If you finish by pressing
[cancel], the contents displayed on the screen is not reflected.

9.3 WELDING START CONDITION - EXE. AT ASF#=x

Outline

If you press [icon]key, when a cursor is at the ARCON ASF#= instruction line, the edit
screen appears as followings.

Entry screen

```
14:39:38** Arc Condition File **A:0 S:4
  ARC START CONDITION FILE           1/2
Cond No    : [ 1] (chg:[Sft]+[Up/Down])
Comment    : [Arc Start Cond 1  ]
Vol Confirm: <Done, Not Done>
Retry      : <OK,No>
Retry Mode : <Reenter,Shift,Weld Path>
Current    : [200] A
Voltage    : [ 20.0] V
WCR Wait   : <Disable,Enbale>
Wait Time  : [0.10] sec
Gas Preflow: [ 0.5] sec (if GasControl)
------------------------------------------
<Initial Condition (Disable:0sec)>  2/2
Initial Time    : [0.00] sec
Initial Current : [  0] A
Initial Voltage : [  0.0] V
Output method   : <constant,Slope>

Select and Enter number. Press [SET]
>
Aux Cond Welder Previous  Next   Save
```

screen contents

■ con. No. : It assigns the welding con. No. (32 conditions are available.)

■ explanation : It records the explanation about usage of the welding condition.

■ voltage check : It sets whether the checked control method of welding power machine is
          unification or individuation.

■ retry : In case of not detecting WCR signal after outputting ARCON signal, it determines
   whether using retry function or not.

■ action mode : It is the moving direction of torch when it retries.

  ① re-entry : In case that arc occurrence is failed, after moving back to before step,
     it tries to make an arc occurrence again. The moving distance can be set as retract
     distance on the welding auxiliary condition retry screen. Because it steps moving

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forward after retracting in certain amount of distance, the voltage/current condition follows the welding start condition.

② Shift : After moving in scheduled moving amount at the retry condition of welding aux. condition, it returns to the arc occurrence step. And it tries to make an arc occurrence in the voltage/current condition at retry condition.

③ welding line move: After moving by scheduled distance at the retract distance of welding aux. condition's retry condition with welding line, it tries to make an arc occurrence in the scheduled voltage/current condition at retry condition. If the arc occurrence is success, after it returns to the welding start point again with holding this arc, it processes the welding.

■ Output current : It inputs the welding current value to output at welding power machine.

■ Output voltage : It inputs the welding voltage value to output at welding power machine.

■ WCR input wait : It selects whether waiting WCR input or not waiting and just processing after outputting the welding condition.

■ Wait time : In case that WCR input wait is " enable" : it displays " wait time" . timeout time, that is WCR input maximum wait time, it processes even though the signal is not detecting.
In case that WCR input wait is " disable" : it displays " delay time" . It is the time when robot is not moving after outputting the condition.

■ Gas blowing out : It inputs the time of gas to blow out before the arc welding starts.

■ Initial condition time : After WCR is input, it sets the holding time of initial current and voltage.

■ Initial current : It sets the current value until WCR is input.

■ Initial voltage : It sets the voltage value until WCR is input.

■ Output type : While an arc welding, it selects whether you make it steep or unchangible which is the status of current and voltage from initial time to the steady state.

Reference

(1) [cancel] ends without saving, " completion" [PF5] ends after saving the changed items.

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9.4 WELDING END CONDITION - EXE. AT AEF#=

OUTLINE

When a cursor is at ARCOF AEF#= instruction line, if you press [icon] key, edit screen is displayed as followings.

Entry screen

```
14:39:38** Arc Condition File **A:0 S:4
 CRATER CONDITION FILE
Cond No      : [ 1] (chg:[Sft]+[Up/Dwn])
Comment      : [Crater Condition 1 ]
Vol Confirm : <Done,Not Done>
StickRecover: <Ok,No>
Current      : [180] A
Voltage      : [20] V
Creater Time: [0.10]sec
Out Method   : <constant,Slope>
Gas Postflow: [ 2.0] sec
Select and Enter number. Press [SET]
>
Aux Cond Welder              Save
```

Screen contents

■ Con. No. : It assigns the welding condition No. (32 conditions are available.)

■ Explanation : It records explanation about usage of the welding condition.

■ Voltage check : It sets what you checked whether the control way is unification or individuation.

■ Auto wire stick release : In case that wire stick is happened after ARCOF is output, it decides whether using the auto wire stick release function or not.

■ Output current : It inputs welding current value to output at the welding power machine.

■ Output voltage : It inputs welding voltage value to output at the welding power machine.

■ Condition holding time : It inputs the time when current and voltage of welding end condition holds.

■ Output way : When the arc welding ends, it selects whether you make it steep or unchangable

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which is condition of current and voltage value from in steady state to in end state.

■ Gas blowing out : It inputs the time when the gas is blew out continuously after Arc off.

Reference

(1) If you press [cancel], it ends without saving, if you press " completion" [PF5], it ends after saving the changed contents.

9.5 WELDING AUXILIARY CONDITION - RETRY

Outline

If you press "aux. condition"[PF1] at the welding start condition file screen, the varieties of auxiliary condition file are displayed separately.

Entry screen

```
14:39:38** Arc Condition File **A:0 S:4
  ARC AUXILIARY CONDITION FILE
<RETRY>
Repetition       : [1] Times
RETRACT Time     : [1.50] sec
Reentr/Path Dist: [  3.00] mm
Shift Dist.  :  X=[  2.00] mm
                Y=[  2.00] mm
                Y=[  2.00] mm
Select and Enter number. Press [SET]
>[1-100]
Restart    ASF                    Save
```

Screen contents

■ Count of times : It assigns the maximum number of times repeating. If arc occurrence fails within number of times assigned, it stops after returning to the reference point (initial arc on occurrence try point, welding start point).

■ RETRACT time : When it retries, it assigns the time when wire is retracted. Torch is moved after Retract, and then it makes arc on after inching.

■ Retract/welding line move : When an action mode is set to re-entry or welding line move, it is the distance of torch when it is retried. An action mode setting is assigned at start condition.

■ Shift move amount : When an action mode is set to shift, it is the move amount of torch when it is retried.

■ Speed : When a retry, it is the speed of body moving to the retry point assigned or returning to the welding start point.

■ Current : It is the output value of welding current when a retry.(It is applied until the body is returned to the welding start point.) But, in case that current value is

0,it starts with the current value of welding start condition.

■ Voltage : It is the output value of welding voltage when a retry.(It is applied until the body returns to the welding start point.) But, in case that voltage value is 0, it starts with the current value of welding start condition.

Reference

(1) It ends without saving when you press [cancel], but it ends after saving the contents changed when you press " completion" [PF5].

9.6 WELDING AUXILIARY CONDITION - RESTART

Outline

If you select " aux. condition" [PF1] at the welding start condition screen and press
" restart" [PF1], restart setting screen is displayed as followings

Entry screen

```
14:39:38** Arc Condition File **A:0 S:4
  ARC AUXILIARY CONDITION FILE
<RESTART>
Repetition      : [2] Times
Overlap Length  : [ 5.0] mm
Speed           : [ 27] cm/min
Current         : [  0] A
Voltage         : [  0.0] V
OVERLAP CONDITIONS
  Arc Off  : <Stop,Conti,SemiAuto,Auto>
  Gas Off  : <Stop,SemiAuto>
  Wire Off : <Stop,SemiAuto>
Select and Enter number. Press [SET]
>
Retry    ASF                      Save
```

Screen contents

■ Number of times : It assigns max. repeating number of times of restart process in the
same welding area.

■ Amount of superposition : It is the distance of superposition(Overlap distance) when
a restart. It starts to weld after returning as long as a superposition distance.

■ Speed : It is a speed of overlapping after moving to superposition position. When error
occurs, it has three times of assigned speed when it moves as long as overlap distance,
and this speed is applied when it welds in overlap area. After welding in Overlap section,
the normal welding speed is applied.

Speed in restart process
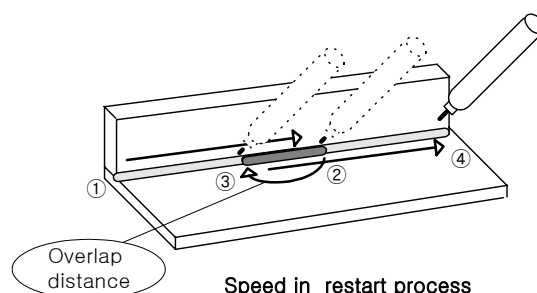
In case that error occurs(②) when a welding processes from welding start point(①) to welding end point(④), it moves in three times of speed assigned here as long as amount of superposition(③). It welds with current, voltage and speed which is assigned at restart until ②, and it welds in normal condition assigned at start condition from ② to ④. But, during a welding in overlap section (from ③ to ②), when error occurs, it immediately starts welding in that point without overlapping again.

■ Current : It is a welding current at superposition section when overlapping. But, when a voltage value is 0, it starts with the current value of welding start condition.

■ Voltage : It is a welding voltage when overlapping. But, when a voltage value is 0, it starts with the voltage value of welding start condition.

■ Overlap condition setting : If Arc Off, Gas Off, Wire Off signal is input when a arc welding, following exe. methods are determined depending on the restart type of welding auxiliary condition file.

(1) Arc Off : It is the processing method when "Arc Off detect" input signal is input.

① Enable : It stops with "current not detecting during E1189 welding" message, and it doesn't do a bid overlap when starting after pressing "start" button again.

② Ignore : It's still working with "current not detecting during E1189 arc welding."

③ Semi-auto : It stops the robot with "current not detecting during E1189 arc welding" message and waits for a manual operation. If you press "start" button in manual operation after clearing error, it returns as long as amount of superposition assigned at restart condition in three times of assigned speed, and outputs condition current and voltage, and welds by arc Off point by making Torch Switch On in a setting speed, and if it gets to arc Off position, it outputs current and voltage value of welding start condition, and it continues to do a normal arc welding to the target point.

④ Auto : It stops the robot with "current not detecting during E1189 arc welding" message and automatically returns to the three times of setting speed at restart condition, and it outputs current and voltage of restart condition, and makes Torch Switch On, and it welds by the arc Off position in a setting speed, and if it gets to the arc Off position, it outputs current and voltage value of the welding start condition, and it continues to do a normal welding to the target point.

----

(2) Gas Off : It is a processing method when " Gas status(enable/disable)" input signal
    is input.

    ① Disable : It stops with " E1275 gas pressure is not enough." message, and it doesn't
        do a bid overlap when it starts after pressing " start" button again.

    ② Semi-auto : It stops the robot to wait manual operation with " E1275 gas pressure
        is not enough." message. If you press "start" button after clearing Error
        by a manual operation, It returns as long as assigned amount of superposition
        from gas Off position, and outputs current and voltage of restart condition,
        and makes Torch Switch On and it welds by gas Off position in a setting speed,
        and if it gets to the gas Off position, it outputs current and voltage value
        of welding start condition and it continues to do a normal welding to the
        target point.

    Reference

    ■ "system"[PF2] → 4. application parameter → 2. arc → 1. If you set a gas pressure
      status input signal "0", it ignores even though signals are input.

(3) Wire Off : It is a processing method when " Wire status(enable/disable)" input signal
    is input.

    ① disable : It stops with " E1276 welding wire is not enough." message, and it doesn't
        do a bid overlap when it starts after pressing "start" button.

    ② seim-auto : It stops the robot to wait manual operation with " E1276 welding wire
        is not enough." message. If you press "start" button after clearing Error
        by a manual operation, it returns as long as assigned amount of superposition
        from wire Off position, and outputs current and voltage of restart condition,
        and makes Torch Switch On and it welds by wire Off position in a setting speed,
        and if it gets to the wire Off position, it outputs current and voltage value
        of welding start condition and it continues to do a normal welding to the target
        point.

    Reference

    ■ "system"[PF2] → 4. application parameter → 2. arc → 1. If you set a Wire status
      input signal "0", it ignores even though signals are input.

9.7 WELDING AUXILIARY CONDITION - AUTO. WIRE STICK RELEASE

Outline

If you select " auxiliary condition" [PF1] at welding end condition, automatic wire stick release setting screen is displayed as followings.

Entry screen

```
14:39:38** Arc Condition File **A:0 S:4
  ARC AUXILIARY CONDITION FILE
<AUTO STICK RECOVERY>
Repeat  :  [1] Times
Current :  [  0] A
Voltage :  [ 20.0] V
Delay   :  [0.30] sec


Select and Enter number. Press [SET]
>[0.0 - 200.0]
    AEF                            Save
```

Screen contents

■ Number of times : It inputs the maximum repeating times of wire stick release.

■ Current : It inputs the output value of welding current during a wire stick release.

■ Voltage : It inputs the output value of welding current during processing a wire stick release.

■ Delay time : It inputs the time when a wire stick release condition outputs.

Reference

■ Move a cursor on the content which you want to change, and press [SET] and inputting numerical number. The setting value will be changed. You should press "completion"[PF5] to save the changed value.

9.8 WEAVING CONDITION FILE

Outline

If you press ![key] key, when there is a cursor in WEAVON WEA#= instruction line, the edit
screen is displayed as followings.

Entry screen

```
14:39:38** Arc Condition File **A:0 S:4
  WEAVING CONDITION FILE
Cond No: [1]
Mode    : <Single,Triangle,L>
Freq.   : [2.5]Hz (0Hz: Moving Time)
Pattern:
    Vertical      [10.0]mm
    Horizontal    [10.0]mm
    Angle         [90.0]deg
Forw Angle:       [ 0.0]deg
.........................................
  Segment         Moving Time
     1      =>    [0.10] sec
     2      =>    [0.10] sec
     3      =>    [0.10] sec
     4      =>    [0.10] sec
  Segment         Timer
     1      =>    [0.00] sec
     2      =>    [0.00] sec
     3      =>    [0.00] sec
     4      =>    [0.00] sec

Select and Enter number. Press [SET]
>
              Previous  Next   Save
```

Screen contents

■ Condition number : It is the number of weaving condition. You can input the number
directly or move to previous or next number by using [ENABLE]+[↑] [↓].

■ Weaving type : It supports simple harmonic motion, triangle wave and L type wave.

■ Frequency : If 0, it selects moving time. Frequency can be set within 0.1~5.0Hz.

■ Basic pattern
(1) Vertical direction : Ver. distance can be input within 1.0~25.0mm.
(2) Horizontal direction : Hor. distance can be input within 1.0~25.0mm.
(3) Angle : Angle can be input within 0.1~180.0 degree.

■ Moving angle : moving angle can be set within -90.0～90.0 degree.

■ Moving time : moving time can be set within 0.04～9.99sec.

■ Timer : timer can be set within 0.00～2.00sec.

   Reference

■ Move a cursor on the content which you want to change, and it is set by inputting numerical
   number or using [Enable]+[→]/[←] key. After changing, if you press [cancel], it ends
   without saving, and if you press "record"[PF5], it ends after saving.

9.9 PROGRAM EDIT IN RUNNING

Outline

If you press ![icon] key when a robot program is playing back, the program edit in running (Hot Edit) screen is displayed as followings. The function explanation about program edit in running (Hot Edit) can be referred to " service" [PF1] -> 4: program edit -> 6: program edit in running(Hot Edit).

```
14:39:38   *** Hot edit  ***    A:0 S:4
                          SR:100% Cont
HotE:022/3/1              PB:022/4/0
S1    MOVE P,S=30%,A=1,T=0
S2    MOVE P,S=50%,A=0,T=0
S3    MOVE P,S=50%,A=0,T=0
      PRINT #1,"READY"
S4    MOVE P,S=50%,A=0,T=0
S5    MOVE P,S=50%,A=0,T=0
S6    MOVE P,S=50%,A=0,T=0
S7    MOVE P,S=50%,A=0,T=0
Select PF menu
>
              Escape Apply   OK
```

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9.10 SPOT WELDING FUNCTION

Outline

When SPOT or M72 (spot welding function) is recorded as a function in editing program,

if you press 🖼 key after moving a cursor on, the screen is displayed as followings.

```
14:39:38*Servo-gun Welding Data*A:0 S:4
    1: Welding condition
    2: Welding sequence




Use [Number]/[Up][Down]and press [SET].
>
```
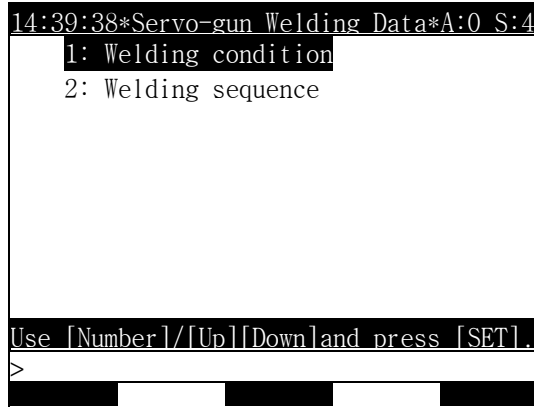
9.10.1 welding condition

If you select welding condition, following screen is displayed. The details about screen are referred to " system" [PF2] → 4: application parameter → 1: spot & stud → 3: spot welding data (condition, sequence) → 2: welding condition part. The difference from this part is that the number of welding condition can not be changed but only the parameter about number of relevant welding condition can be changed.

```
14:39:38 *** Weld Condition *** A:0 S:4
Welding Cond.  1
Output data    =[   1]
Output type    =< Discrete,Binary >
Squeeze force  =[ 50](Kgf)




Select and Enter number. Press [SET]
>[50 - 999]
```
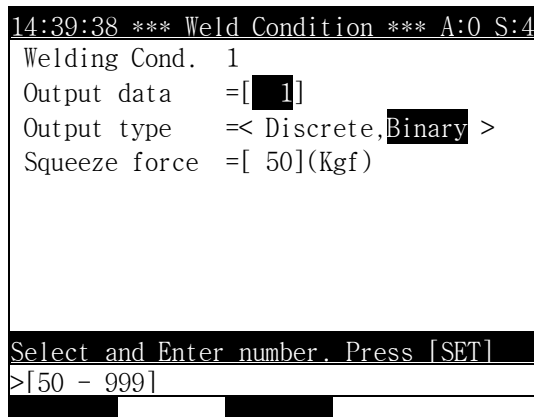
9.10.2 welding sequence

If you select welding sequence, following screen is displayed. The detail about screen can be referred to " system" [PF2] → 4: application parameter → 1: spot & stud → 3: spot welding data (condition, sequence) → 2: welding system part. The difference from this part is that the number of welding sequence can not be changed but only the parameter about relevant welding sequence number can be changed.

```
14:39:38  *** Weld Sequence *** A:0 S:4
Welding Sequence  1
Condition signal       =< DSBL,ENBL >
Squeeze signal         =< DSBL,ENBL >
Welding command signal=< DSBL,ENBL >
WI wait                =< DSBL,ENBL >
Welding wait time     =[0.00]
Welding end wait time =[0.00]



Press [SHIFT]+[<-][->] Key.
>

```

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Chapter 10. Menu Tree

CONTENTS

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CHAP. 10 MENU TREE

10.1 MENU LIST

This picture displays groups that each instruction is located at initial menu and instruction input.

```
                              ┌──────────┐                      ┌──────────┐
                              │   CMD    │                      │ function │
                              └──────────┘                      └──────────┘
        ┌──────────┬──────────┼──────────┬──────────┐              ABS
   MOVE, I/O    FlowCtrl      Etc.     ARC Weld    Assign           MAX
                                                                   MIN
     MOVE        GOTO          '        ARCON        V           DEGRAD
     PRINT       GOSUB        REM       ARCOF       pose         RADDEG
     INPUT       CALL        M code     WEAVON      shift          SQR
     Sig.Out     IF          I code     WEAVOF      out            SIN
     WAIT        FOR         T code     REFP        in             COS
     SMOV        RETURN      CALLPR     ARCCUR    System           TAN
                 ELSEIF      LETN       ARCVOL                     ATN
                 ELSE        TIERST     ARCDC                      ATN2
                 ENDIF       PALPU      ARCDV                      DIST
                 NEXT        PAL                                   ORD
                 ON GOTO     PALEND                                VAL
                 JMPP        PALRST                              STRPOS
                 DELAY       SEA                                   LEN
                 STOP        SELCRD                               TIMER
                 END         SONL                                 CHR$
                 레이블       SPOTCND                              STR$
                             SREQ                                  BIN$
                             SREQT                                 HEX$
                             SXYZ                                 MIRROR$
                             TONL1                                LEFT$
                             TONL2                                MID$
                             RINT                                RIGHT$
                             RINTA                                DATE$
                             CNVSYNC                              TIME$
                             CLR232C
                             SPOT
                             GUNSEA
```

10.2 Move, I/O

Grammar: *MOVE <interpolation> [,<pose>] , S=<speed> , A=<accuracy> , T=<TOOL> [,MX] [,MX2]*
[,G1] [,G2] [,BM] [,UNTIL <conditional expression>]

```
MOVE            P              ,P1                              ,S=100
                                                               
  └─ MOVE       ├─ OFF         ├─ P        ┌─ +R  ─── +LR        ├─ Unit
                │              │           │                     │
                ├─ Linear      ├─ P[ ]     ├─ +R[ ] ─ +LR[ ]     ├─ mm/sec, sec
                │              │           │                     │   cm/min, %
                └─ Circular    ├─ P*       ├─ Local ─ Global     ├─ Conversion
                               │           │                     │
                               ├─ P.Const  ├─ Variable ─ Variable├─ mm/sec, sec
                               │           │                     │   cm/min, %
                               └─ Local    └─ Expr. ── Expr.      ├─ Variable
                                                                  │
                                                                  └─ Expr.
```

```
,A=0          ,H=0          ,_MX          UNTIL _DI20=1

 ├─ Variable   ├─ Variable   ├─ MX          ├─ <
 │             │             │              │
 └─ Expr.      └─ Expr.      ├─ MX2         ├─ >
                             │              │
                             ├─ G1          ├─ =
                             │              │
                             ├─ G2          ├─ Variable
                             │              │
                             └─ BM          └─ Expr.
```

Grammar: *PRINT <ouput direction> , <information,...>*

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```
PRINT              #0              ,V1%
  │                 │                │
  └──┌─────┐        ├──┌─────┐       ├──┌─────┐
     │PRINT│        │  │ T/P │       │  │  ,  │
     └─────┘        │  └─────┘       │  └─────┘
                    │                │
                    ├──┌─────┐       ├──┌─────┐
                    │  │COM1 │       │  │  ;  │
                    │  └─────┘       │  └─────┘
                    │                │
                    └──┌─────┐       ├──┌──────┐
                       │COM2 │       │  │String│
                       └─────┘       │  └──────┘
                                     │
                                     ├──┌────────┐
                                     │  │Variable│
                                     │  └────────┘
                                     │
                                     └──┌─────┐
                                        │Expr.│
                                        └─────┘
```

Grammar: **INPUT <input direction> , <variable> [,<timeout time>]**

```
                             ,V1%
INPUT            #0             │
  │              │              │           ,_100
  └──┌─────┐     ├──┌─────┐     ├──┌─────┐     │
     │INPUT│     │  │ T/P │     │  │  V  │     ├──┌────────┐
     └─────┘     │  └─────┘     │  └─────┘     │  │Variable│
                 │              │              │  └────────┘
                 ├──┌─────┐     ├──┌─────┐     │
                 │  │COM1 │     │  │pose │     └──┌─────┐
                 │  └─────┘     │  └─────┘        │Expr.│
                 │              │                 └─────┘
                 └──┌─────┐     ├──┌─────┐
                    │COM2 │     │  │shift│
                    └─────┘     │  └─────┘
                                │
                                ├──┌─────┐
                                │  │ out │
                                │  └─────┘
                                │
                                ├──┌─────┐
                                │  │ in  │
                                │  └─────┘
                                │
                                └──┌──────┐
                                   │System│
                                   └──────┘
```
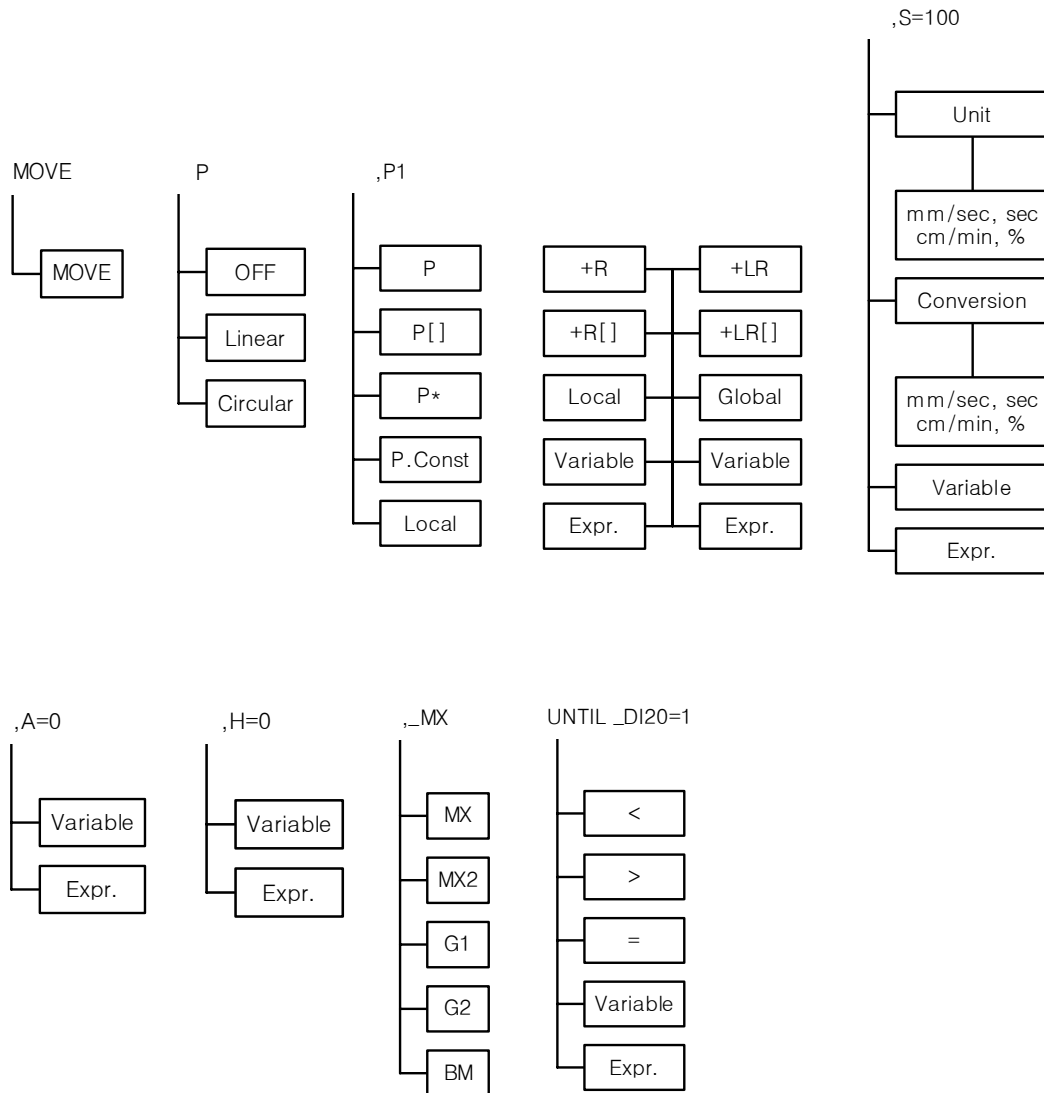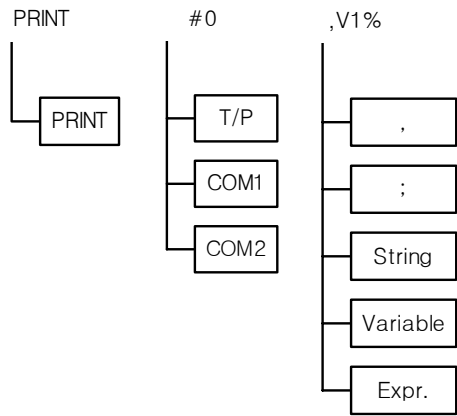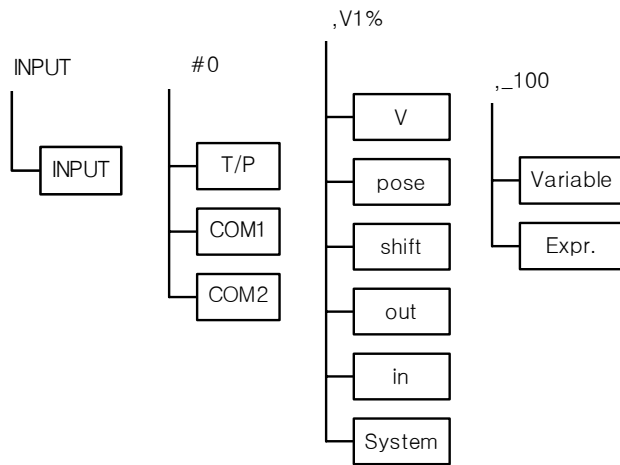
Signal output (DO signal): It is the same as <variable>'s <out> menu.

WAIT <conditional expression> [,<timeout time>, <feedback address>]

```
WAIT            DI20=1          ,_1           ,_1
  │               │              │             │
  └──┌────┐       ├──┌─────┐     ├──┌────────┐ ├──┌──────┐
     │WAIT│       │  │  <  │     │  │Variable│ │  │ STEP │
     └────┘       │  └─────┘     │  └────────┘ │  └──────┘
                  │              │             │
                  ├──┌─────┐     └──┌─────┐    ├──┌──────┐
                  │  │  >  │        │Expr.│    │  │LABEL │
                  │  └─────┘        └─────┘    │  └──────┘
                  │                            │
                  ├──┌─────┐                   └──┌────────┐
                  │  │  =  │                      │Line no.│
                  │  └─────┘                      └────────┘
                  │
                  ├──┌────────┐
                  │  │Variable│
                  │  └────────┘
                  │
                  └──┌─────┐
                     │Expr.│
                     └─────┘
```
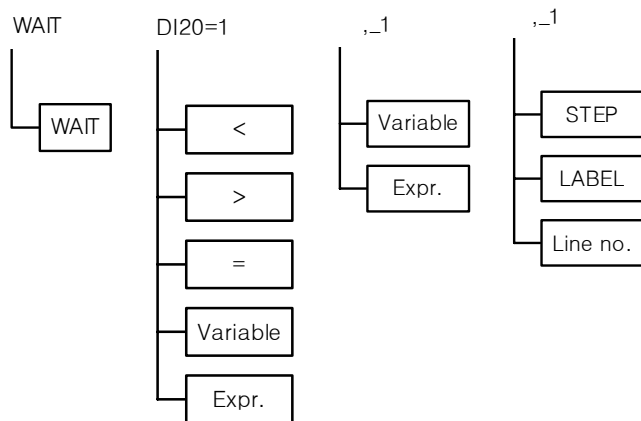
10.3 FLOW control

IF <conditional expression> THEN <address> [ELSE <address>]
IF <conditional expression> THEN ~ [ELSEIF <conditional expression> THEN ~] [ELSE ~]
ENDIF

```
IF          V1%=1 THEN       _1              _ELSE 10           ELSEIF       V1%=1 THEN

    ┌──┐       ┌────────┐      ┌────────┐      ┌────────┐       ┌────────┐      ┌────────┐
    │IF│       │   <    │      │ STEP   │      │ STEP   │       │ ELSEIF │      │   <    │
    └──┘       ├────────┤      ├────────┤      ├────────┤       └────────┘      ├────────┤
               │   >    │      │ LABEL  │      │ LABEL  │                        │   >    │
               ├────────┤      ├────────┤      ├────────┤                        ├────────┤
               │   =    │      │Line no.│      │Line no.│                        │   =    │
               ├────────┤      └────────┘      └────────┘                        ├────────┤
               │Variable│                                                        │Variable│
               ├────────┤                                                        ├────────┤
               │ Expr.  │                                                        │ Expr.  │
               └────────┘                                                        └────────┘
```

FOR <variable name>=<initial value> TO <end value> [STEP <augmenter>] ~ NEXT

```
FOR            ,V1%                 1          TO 10          _STEP 10

    ┌───┐       ┌────────┐                  ┌────────┐      ┌────────┐
    │FOR│       │   V    │      ┌────────┐   │Variable│      │Variable│
    └───┘       ├────────┤      │Variable│   ├────────┤      ├────────┤
                │  pose  │      ├────────┤   │ Expr.  │      │ Expr.  │
                ├────────┤      │ Expr.  │   └────────┘      └────────┘
                │ shift  │      └────────┘
                ├────────┤
                │  out   │
                ├────────┤
                │   in   │
                ├────────┤
                │ system │
                └────────┘
```

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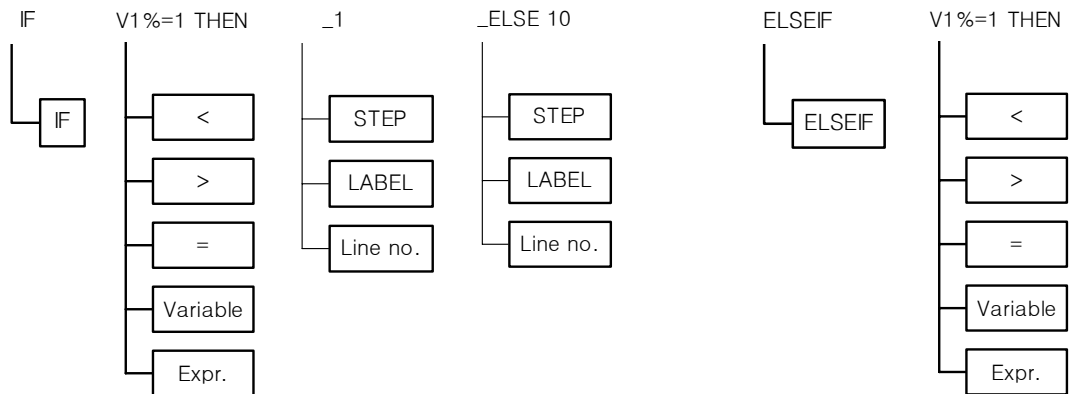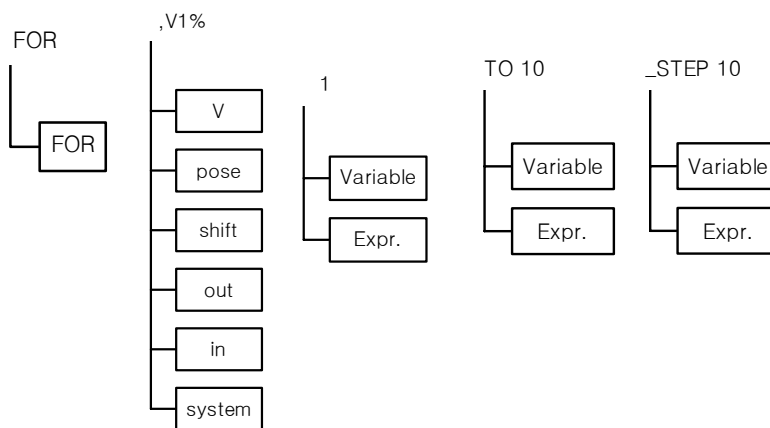
GOTO <address>   ON <number> GOTO <address> [,<address>,...]

JUMP(CALL)

GOSUB <address> ~ RETURN

  <program number>

```
   GOTO 1                 ON V1%      GOTO 1           ,_1              JMPP 1
   GOSUB 1                                                             CALL 1

     ┌──────┐            ┌──────────┐  ┌──────┐      ┌──────────┐     ┌──────────┐
     │ STEP │            │ Variable │  │ STEP │      │ STEP     │     │ Variable │
     └──────┘            └──────────┘  └──────┘      └──────────┘     └──────────┘
     ┌──────┐            ┌──────────┐  ┌──────┐      ┌──────────┐     ┌──────────┐
     │ LABEL│            │ Expr.    │  │ LABEL│      │ LABEL    │     │ Expr.    │
     └──────┘            └──────────┘  └──────┘      └──────────┘     └──────────┘
     ┌──────────┐                      ┌──────────┐  ┌──────────┐
     │ Line no. │                      │ Line no. │  │ Line no. │
     └──────────┘                      └──────────┘  └──────────┘
```

DELAY <time>

```
   DELAY            ,1

     ┌───────┐        ┌──────────┐
     │ DELAY │        │ Variable │
     └───────┘        └──────────┘
                      ┌──────────┐
                      │ Expr.    │
                      └──────────┘
```
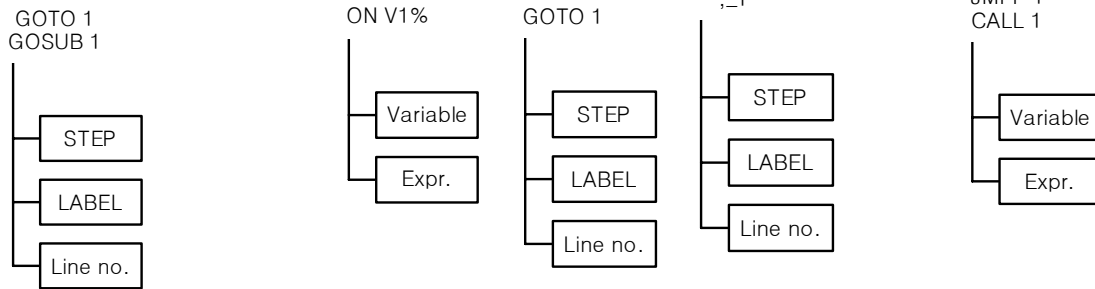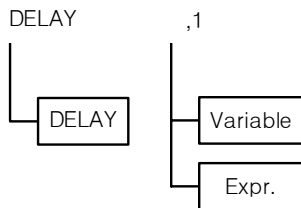
* (LABEL): It starts with an alphabet within 8 characters. an alphabet, number, under bar(_) is available.

10.4 ETC.

```
┌─────────────────┐   All instruction input methods except REM are the same as the old
│ REM _COMMEMT    │   M code input method.
└─────────────────┘   It inputs by using guide frame and input (status) frame without menu.
        │
        └── (input state)
```

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10.5 ARC

ARCON [ASF#=<file number>]   ARCON C=<current output value> ,
{V=<voltage output value>|VP=<voltage ratio>}
[,T=<time>] [,RETRY]

```
 ARCON              _ASF#=1        ARCON           _C=100         ,V=100         ,_T=1          ,_RETRY
   |                  |              |               |              |              |              |
 ┌──────┐          ┌──────┐      ┌──────┐        ┌──────┐       ┌──────┐       ┌──────────┐    ┌──────┐
 │ARCON │          │  C   │      │ARCON │        │ ASF# │       │  VP  │       │ Variable │    │RETRY │
 └──────┘          └──────┘      └──────┘        └──────┘       └──────┘       └──────────┘    └──────┘
                   ┌──────────┐                  ┌──────────┐   ┌ ─ ─ ─┐       ┌──────┐
                   │ Variable │                  │ Variabe  │   │  V   │       │ Expr.│
                   └──────────┘                  └──────────┘   └ ─ ─ ─┘       └──────┘
                   ┌──────┐                      ┌──────┐       ┌──────────┐
                   │ Expr.│                      │ Expr.│       │ Variable │
                   └──────┘                      └──────┘       └──────────┘
                                                               ┌──────┐
                                                               │ Expr.│
                                                               └──────┘
```

ARCOF [AEF#=<file number>]   ARCOF C=<current output value> ,
{V=<voltage output value>|VP=<voltage ratio>}
[,T=<time>] [,ANTSTK]

```
 ARCOF        _AEF#=1       ARCOF        _C=100        ,V=100        ,_T=1         ,_ANTSTK
   |            |             |            |             |             |             |
 ┌──────┐    ┌──────┐     ┌──────┐     ┌──────┐      ┌──────┐      ┌──────────┐   ┌────────┐
 │ARCOF │    │  C   │     │ARCOF │     │ AEF# │      │  VP  │      │ Variable │   │ ANTSTK │
 └──────┘    └──────┘     └──────┘     └──────┘      └──────┘      └──────────┘   └────────┘
             ┌──────────┐              ┌──────────┐  ┌ ─ ─ ─┐      ┌──────┐
             │ Variable │              │ Varibale │  │  V   │      │ Expr.│
             └──────────┘              └──────────┘  └ ─ ─ ─┘      └──────┘
             ┌──────┐                  ┌──────┐      ┌──────────┐
             │ Expr.│                  │ Expr.│      │ Variable │
             └──────┘                  └──────┘      └──────────┘
                                                     ┌──────┐
                                                     │ Expr.│
                                                     └──────┘
```
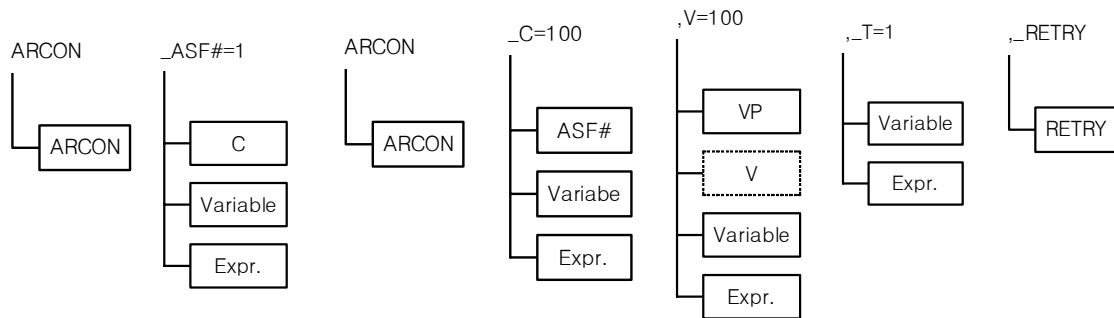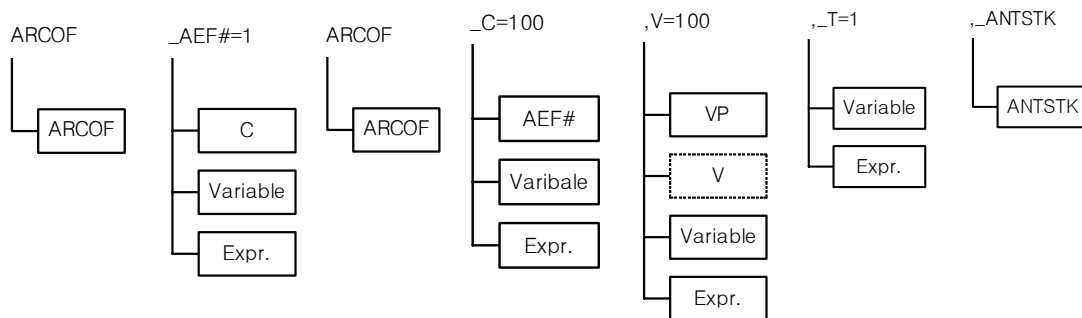
ARCCUR C=<current output value> ARCVOL {V=<voltage output>|VP=<voltage ratio>}
ARCDC <current instruction value>   ARCDV <voltage instruction value>

ARCCUR   C=100   ARCVOL   V=100

```
ARCCUR          C=100              ARCVOL          V=100
  └── ARCCUR      ├── Variable       └── ARCVOL       ├── VP
                  └── Expr.                           ├── V
                                                      ├── Variable
                                                      └── Expr.
```

```
ARCDC 10         ARCDV 10
  ├── Variable     ├── Variable
  └── Expr.        └── Expr.
```

WEAVON WEV#=<file number> REFP <reference point number> , [<auxiliary point>]

```
WEAVON          WEV#=1              REFP          1,          P1
  └── WEAVON      ├── Variable        └── REFP                ├── P
                  └── Expr.                                   ├── P[ ]
                                                              ├── P*
                                                              ├── P.const
                                                              └── Local
```
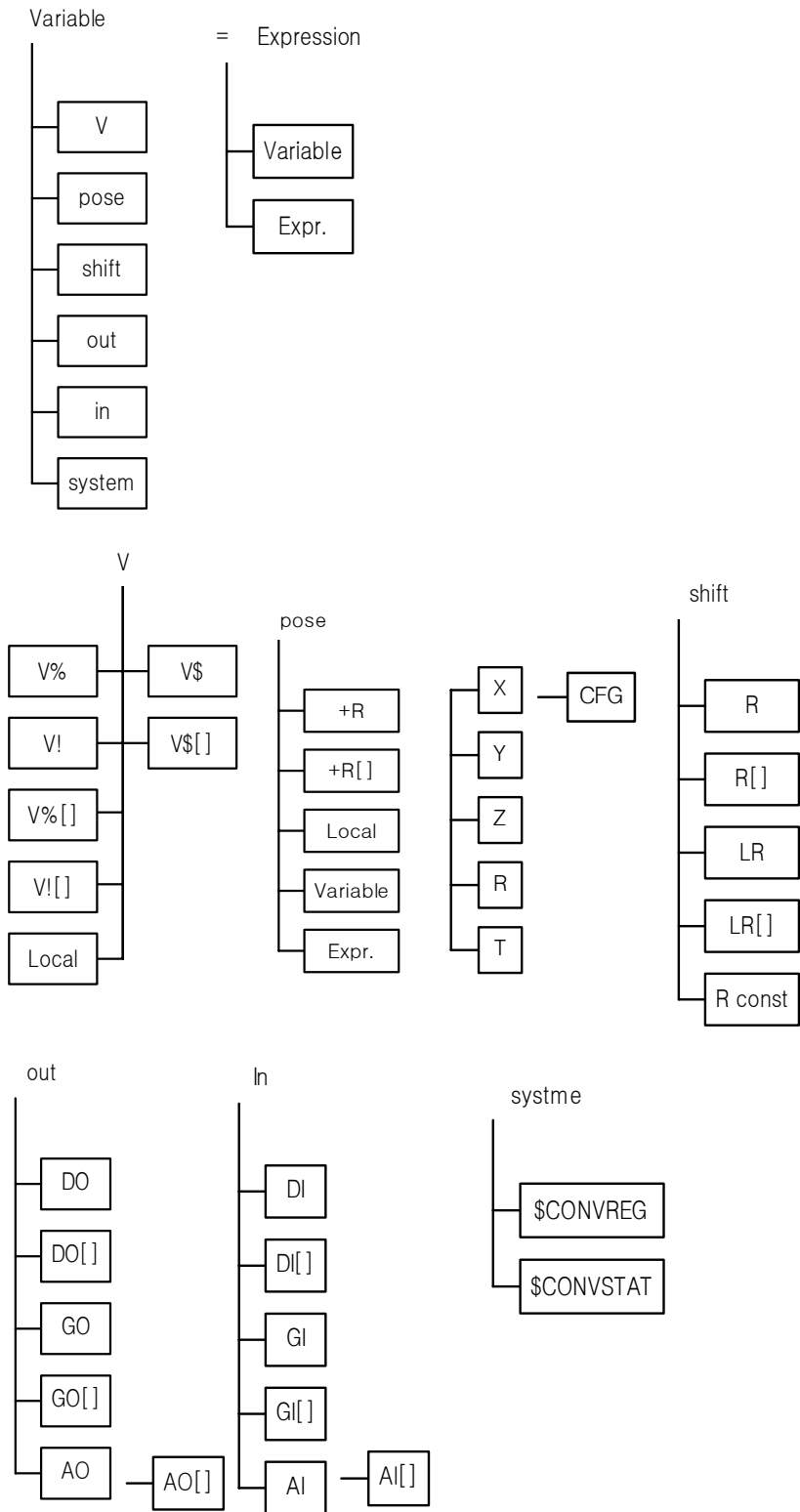
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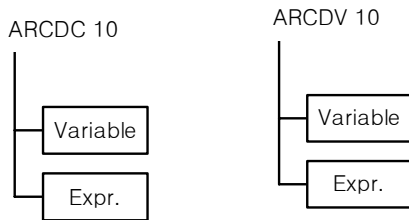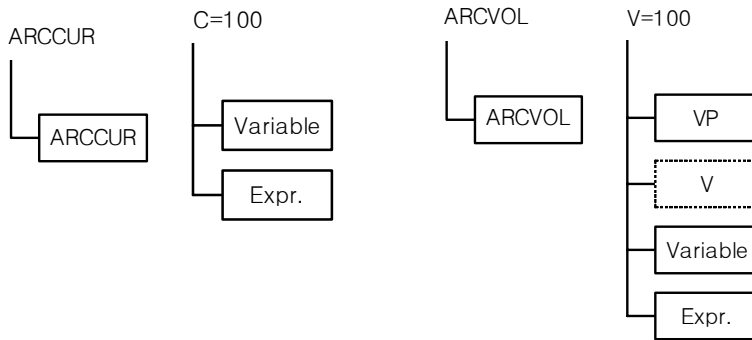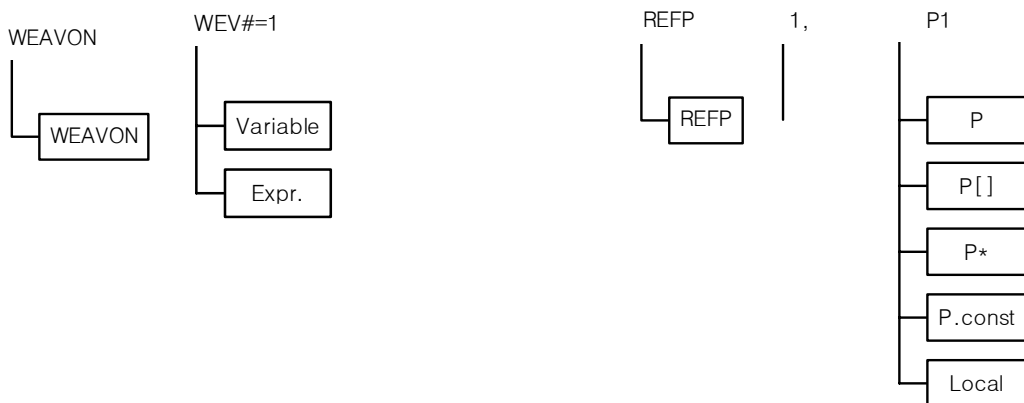
10.6 substitutional Statement

It is a form of "variable=expression". In all case that arithmetic statement can be input as well as substitutional statement, formula menu is supported. At this time, variable menu is as followings. Formula input can be referred to the explanation (screen) about instruction statement edit.

Variable

= Expression

```
        V
      pose
     shift
      out
       in
    system
```

```
  Variable
   Expr.
```

V

```
V%        V$
V!        V$[]
V%[]
V![]
Local
```

pose

```
  +R
  +R[]
 Local
Variable
 Expr.
```

```
X  —  CFG
Y
Z
R
T
```

shift

```
   R
  R[]
  LR
 LR[]
R const
```

out

```
  DO
 DO[]
  GO
 GO[]
  AO  —  AO[]
```

In

```
  DI
 DI[]
  GI
 GI[]
  AI  —  AI[]
```

systme

```
$CONVREG
$CONVSTAT
```

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Chapter. 11 Robot Language Explanation

CONTENTS

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CHAP. 11 ROBOT LANG. EXPLANATION

There are two ways to teach an industrial robot greatly. One is an instruction code method, and the other is a robot language method.
Our old controller model such as Hi3CE, Hi3TB, etc.. in Hi controller series has an instruction code method to teach.

instruction code of Hi controller

section	class	role	example
step	step code	move of tool end in robot	340.5mm/s(L) A0 T0 G1 X2 speed 340mm/s accuracy 0, tool 0, gun1, X2
function	M code	signal input/output jump, call, stop conditional jump, call, stop repeating execution conditional repeating execution setting on-line shift welding condition, palletize etc. various application function execution. etc....	M1 1 DI1 signal output M20 step jump M81 5,I1 DI conditional program call M44 3,50 GI3 group signal output M53 1,1,5,7 online coordinate conversion M33 2 spot welding condition output M99 'spot comment statement
	I code	DI signal wait	I25 I18 DI18 signal wait I53 IB1,101,2,0 time conditional GIsignal(AND)
	T code	time delay	T 5.0 5sec. wait

A teaching person can make a work program which can control a robot action fussily by using hundred tens of instruction codes. But, it is very difficult or almost impossible to make a program with instruction codes that needs numerical formula or string process and many data's saving and process. Also, it is difficult to analyze a program for beginner because instruction codes are consists of number codes.

On the other hand, robot language method supply that various arithmetics, string variable, functions and numerical formula type with instruction statement groups in English.
It is general that industrial robot makers has their own unique robot language. Hyundai Hi4 has its unique robot language named HR-BASIC. This language is similar with BASIC language grammar which is used in PC.

11.1 basic elements

11.1.1 Line

Line number can be added at forefront of line.(optional).

254 characters can be described in 1 line. 1 line can has only 1 instruction statement.

11.1.2 Character

letter	A ~ Z, a ~ z, Korean (capital character can be usable except in comment statement contents and string)
digit	0 ~ 9
symbol	! " ' # $ % & ( ) * + - . , / ₩ : ; = < > ? @ ` [₩] ^ { } | _
space	\<space\> \<tab\>(conversion to \<space\> before transmission to controller)

11.1.3 Address

explana-tion	line No., step No. or label. It is used for jump such as GOTO, GOSUB, etc. line No. can be omit.	
step number	S0~S999	step No. is automatically numberring when MOVE statement is used.
line No.	1~9999	The procedure of line No. is not connected to the procedure of program execution.
label	*\<label name\>	label name can be consists of alphabet and under bar within 8 characers. It should start with alphabet.
example for use	50 PRINT.... *ERRHDL	GOTO 10 GOSUB *CALC

Reference

(1) Unsigned integer can only be used in line No. and step No.

   (real number, arithmetic statement X)

(2) Label number per program is within 100.

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11.1.4 Constant

constant type		range	example
constant	dec.	-32768～32767	2150, -440
	bin.	&B0～B1111111111111111	&B01101011, &B1000
	hex.	&H0～&HFFFF	&H3F77, &H2A
real number		-3.4E+38～3.4E+38	55.6, 0.5E-2
string		enable with 35 char.	"INPUT WORK NUMBER:", "INVALID DATA"

constant type	coordinate type	range	example
pose	basic coordinate system	real number range	(204.5, 3719.35, 277.94, 0, 50, 0, 24) (P* is present pose of robot)
	robot coordinate system	real number range	(204.5, 3719.35, 277.94, 0, 50, 0, 24)R
	encoder type	0～&HFFFFFFFF	(&H400000,&H400000,&H400000, &H400000,&H400000,&H400000)E
shift	basic coordinate system	real number range	(0, 50, 0, 0, 0, 0)
	tool coordinate system	real number range	(0, 50, 0, 0, 0, 0)T (if T, tool coordinate system reference)

Reference

(1) Suffix is not added in basic coordinate system, but suffix is added in robot coordinate system.

(2) In case of basic coordinate system or robot coordinate system, each elements are (X, Y, Z, RX, RY, RZ, cfg.). If there is an additional axis, it is continued after RZ. X, Y, Z are coordinate(unit: mm), RX, RY, RZ are each rotational angle of x axis, y axis, axis(unit: degree).
cfg.(configuration) is consists of 8bit (0～255) robot type information.

(3) In case that there is not additional axis, it is the same whether R is added or not.

(4) In case of encoder type, suffix is added.

(5) Each elements of encoder type is (S, H, V, R2, B, R1), and there is not cfg. If there is an additional axis, it is continued after R1.

(6) In case that T is added, only tool coordinate system is applied, so even though user coordinate system is set, it is ignored.

11.1.5 Robot type information

9~7 bit	6 bit	5 bit	4 bit	3 bit	2 bit	1 bit	0 bit
0: base 1: robot 3: encoder	0: R2<180 1: R2>=180	0: R1<180 1:R1>=180	0: S<180 1: S>=180	0: flip 1: noflip	0: up 1: down	0: front 1: rear	0: manual 1: auto

Reference

(1) 0 bit : It is an auto. cfg. function. If it is 0, type information assigned at 1 bit~6 bit is applied, if it is 1, it uses proper type created ignoring assigned type.

(2) 9~7 bit : It is a coordinate type of pose. When you want to use by reading coordinate information of pose in program routine, this bit is used. In case that it is set differently between coordinate system suffix and this bit, you can follow suffix.

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11.1.6 Variable

11.1.6.1 Global variable

It can be shared and used in whole program.

variable type		grammar	example
arithmetic	contsant	V1%~V400% or V%[1]~V%[400]	V10%, V%[20], V%[50+V2%] (The type of numerical formula can be written in [ ].)
	real number	V1!~V400! or V![1]~V![400]	V10!, V![20], V![50+V2%]
strings		V1$~V40$ or V$[1]~V$[40]	V10$, V$[20], V$[V2%]
pose		P1~P999 or P[1]~P[999]	P50, P[70], P[50+V2$] , P[20].RZ, P[10].X (The access to the elements (X, Y, Z, RX, RY, RZ, T1, T2,... T6, CFG) are available.)
shift		R1~R100 or R[1]~R[100]	R20, R[30], R[20+V2$], R[20].RZ, R[10].X (The access to the elements (X, Y, Z, RX, RY, RZ) are available.)

Reference

(1) Pose type elements and shift type elements are dealt as real number type.

(2) The number of pose element T1, T2... should be matched with the number of additional axis.

(3) When pose is encoder type, (S, H, V, R2, B, R1) elements can be accessed by using each X, Y, Z, RX, RY, RZ.

(4) At the time when controller's system is initialized, all arithmetics type variables, pose and variable elements become 0, and string variables are initialized to blank string. It is not initialized automatically when the cycle begins and program is changed.

(5) All variables are reserved even though the power is turned off.

11.1.6.2 Local variable

It exists separately in each main program and auxiliary program called. It is impossible to access local variables of other program.

variable type		grammar	example
arithmetic	constant	LV1%~LV50% or LV%[1]~LV%[50]	LV10%, LV%[5], LV%[5+LV2%] (The type of numerical formula is only written in [ ].)
	real number	LV1!~LV50! or LV![1]~LV![50]	LV10!, LV![5], LV![5+LV2%]
string		LV1$~LV10$ or LV$[1]~LV$[10]	LV10$, LV$[5], LV$[LV2%]
pose		LP1~LP100 or LP[1]~LP[100]	LP5, LP[7], LP[5+LV2$], LP[2].RZ, LP[10].X (Access to elements (X, Y, Z, RX, RY, RZ, T1, T2,... T6, CFG) is possible.)
shift		LR1~LR50 or LR[1]~LR[50]	LR2, LR[3], LR[2+LV2$], LR[2].RZ, LR[10].X (Access to elements (X, Y, Z, RX, RY, RZ) is possible.)

  Reference

(1) Pose type elements and shift type elements are dealt as real number type.

(2) The number of pose element T1, T2... should be matched with the number of additional axis.

(3) When pose is a encoder type, (S, H, V, R2, B, R1) elements can be accessed by using each X, Y, Z, RX, RY, RZ.

(4) At the time when controller's system is initialized, all arithmetics type variables, pose and variable elements become 0, and string variables are initialized to blank string. It is not initialized automatically when the cycle begins and program is changed.

(5) All variables are reserved even though the power is turned off.

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11.1.6.3 Input/output variable

output variable	single general output DO (bit)	DO1~256	DO2=1 (If 0, RESET, If not 0, SET) (SET general output signal DO2)
	group general output GO (byte)	GO1~32	GO3=&B00001111 or GO3=&H0F (Output 0F(HEX) through GO3)
	single dedicated output SO (bit)	SO1~8	SO4=0 (if 0, RESET, if not 0, SET) (RESET dedicated output signal SO4)
	analogue AO	AO1~4	AO1 = 3.5 (output 3.5 V through analog No. 1 output channel)
input variable	single dedicated input DI (bit)	DI1~240	V2%=DI3 (it becomes 1 or 0, read only variable) (Set present status of general input signal DI3 to V2% variable)
	group general input GI (byte)	GI1~30	V3%=GI4 (0~255, read only variable) (Set present status of group general input signal GI4 to V3% variable)
	single dedicated input SI (bit)	SI1~8	V3%=SI4 (It becomes 1 or 0, read only variable) (Set present status of dedicated input signal to V3% variable)
	analogue AI	AI1~4	V3!=AI2 (read only variable) (Substitute input channel value of analog No.2 to %V3! variable)

Reference

(1) When you use index as a type of numerical type, write it in [] like DO[], GO[], AO[].

(2) The range of analog input/output value is -12V~12V when it is based that BD480 is equipped.

11.1.6.4 System variable

These are variables to get or to set the information of inner system. In present, there are variable which is relevant to number of times register and two read only variables which are relevant to option board.

Read only variable is not substituted. It means that it can't be located in left side of the substitutional statement.

_RN1~16 or _RN[1]~_RN[16]	It's relevant to number of times register No.1~No.16	
$CONVREG	Encoder pulse count value of option board	Read only
$CONVSTAT	Status of option board Bit 0 : status in encoder singer wire short(active high) Bit 1 : start limit switch(active high)	Read only

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11.1.7 Operator

( )
sign(+ -)
^
* / ₩ MOD
+ -
= ◇ < > <= >=
NOT
AND OR XOR

high
priorit
↑

↓

low
priorit

example
V10! = (V1!^2 + V2!^2 + V3!^2)*2.5
IF(V24!>=V50! AND V10$= " WELD"

(1) Three operators are available in String operation which are +(connection between two strings), =(equal) and ◇(difference).

(2) Pose operation can be used only in type of <pose>+<shift>.

(3) ₩ is a integer division operator that the value of left side's divided operator is divided by the value of right side's value and it is rounded off.

(4) MOD is a operation that finds remainder of division.

(5) AND, OR, XOR are bit operators, and if you want to use it as a logical operator, we recommend that operand should be 0 or 1. So at that time, the result can be accurate.

(6) NOT is only used as a bit operator, and logical NOT is not exist. So we recommend you to use ◇ instead.

(7) In case of operation between integer and real number, integer is converted to real number automatically and then the operation is executed.
(The result type of operation is real number type.)

11.1.8 Formula

arithmetic statement	Integer, real number, integer type variable, real number type variable, arithmetic function, pose element, shift element, it includes operation which has integer type or real number type in result. Example: -10, 10.12, V1%, V1!, SQR(V1%), P1.X, R2.Y, (V2!+V3!)/2+&HC000
string statement	String constant, string variable, string function, it includes operation which has string type in result. Example: "COMM ERR", "ABCD"+"EFCD", LEFT$("ROBOT INIT", 5)
pose statement	Pose constant, pose variable, it includes operation which has pose type in result. Example: (204.5, 37.35, 2.94, 0, 50, 0, 24)R+(0, 10, 0, 0, 0, 0)H, P1+R1

11.2 Command line

11.2.1 Substitution

Description	Substitute the value to the variable.	
Syntax	<Variable>=<Value>	
Parameter	Variabl	Arithmetic, String, Pose, Shift
	Value	Arithmetic, String, Pose, Shift constant, and shift variable
example	V5%=20 V![V1%]=5.5 V2$= "EMERGENCY STOP!!" P3 = P3+R1 R2 = (0, 100, 0, 0, 0, 0)	
Comment	The value type must be identical to the variable type. However, the integer and float types are automatically converted for each other.	

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11.2.2 Robot Control

11.2.2.1 MOVE Command

Description	The tool end of the robot moves to pose position.		
Syntax	MOVE <Interpolation>, [<Pose>], S=<Speed>, A=<Accuracy>, H=<Tool Number>　　　　[,<Output Option>] [UNTIL <Condition>[,<Interrupt Status Variable>]]		
Parameter	Interpolation	P : No Interpolation,　　L : Straight,　　C : ARC	
	Pose	Pose type, Target pose to move. If there is hidden pose, it is omitted or only the shift type is specified.	
	Speed	Arithmetic Equation. The moving speed of the tool end. Unit(mm/sec, cm/min, sec, %) has to be accompanied.	
	Accuracy	Arithmetic Equation.　　　0~3　0 is most accurate	
	Tool Number	Arithmetic Equation.　　　0~3	
	Output Option	MX, MX2, G1, G2, BM　(Multiple selection possible)	
	Condition	If the condition is met, robot operation stops and it is assumed to reach the specified pose.	
	Interrupt Status	Saves the result of the condition. Provides the information if Move command is exited by the condition.	Used with UNTIL command
example	MOVE C, P[0]+R[1], S=800mm/s, A=0, H=1 MOVE P, R1, S=80%, A=1, H=3 UNTIL DI1=1　　　　(hidden pose) MOVE L, S=0.5sec, A=0, H=0, MX, G1 UNTIL DI2=&H7F, V1% (hidden pose)		

Note

(1) If Move command is input by using <REC> key of T/P, it becomes hidden pose type.

(2) If shift data is recorded in the pose position by using T/P, it becomes hidden pose type.

(3) There are MX, G1, PU, PK, PS in the output option of palletizing mode. Signals such as MX and G1 or PU, PK, PS cannot be used simultaneously. Detailed is referred to the Palletizing function.

(4) When using robot equalizing, G1 and G2 cannot be used simultaneously.

11.2.2.2 SMOVE Command

Description	The tool end of the robot moves to pose position with positioner synchronizing.	
Syntax	SMOVE <Interpolation>, [<Pose>], S=<Speed>, A=<Accuracy>, H=<Tool Number> [,<Output Option>] [UNTIL <Condition>[,<Interrupt Status Variable>]]	
Parameter	Positioner No.	Referred to the positioner synchronizing.	
	Interpolation	P : No Interpolation, L : Straight, C : ARC	
	Pose	Pose type, Target pose to move. If there is hidden pose, it is omitted or only the shift type is specified.	
	Speed	Arithmetic Equation. The moving speed of the tool end. Unit(mm/sec, cm/min, sec, %) has to be accompanied.	
	Accuracy	Arithmetic Equation. 0~3 0 is most accurate	
	Tool Number	Arithmetic Equation. 0~3	
	Output Option	MX, MX2, G1, G2, BM (Multiple selection possible)	
	Condition	If the condition is met, robot operation stops and it is assumed to reach the specified pose.	
	Interrupt Status	Saves the result of the condition. Provides the information if Move command is exited by the condition.	Used with UNTIL command
example	MOVE C, P[0]+R[1], S=800mm/s, A=0, H=1 MOVE P, R1, S=80%, A=1, H=3 UNTIL DI1=1　　　　(hidden pose) MOVE L, S=0.5sec, A=0, H=0, MX, G1 UNTIL DI2=&H7F, V1% (hidden pose)	

Note

(1) Detailed about Positioner Synchronizing is referred to the Positioner Synchronizing operation manuals.

(2) If Move command is input by using <REC> key of T/P in the position synchronizing mode, it becomes hidden pose type.

(3) If shift data is recorded in the pose position by using T/P, it becomes hidden pose type.

(4) There are MX, G1, PU, PK, PS in the output option of palletizing mode. Signals such as MX and G1 or PU, PK, PS cannot be used simultaneously. Detailed is referred to the Palletizing function.

(5) When using robot equalizing, G1 and G2 cannot be used simultaneously.

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11.2.3 I/O

11.2.3.1 I/O Substitution

Description	Outputs DO signal or inputs the DI signal status.	
Syntax	\<Output Variable\> = \<Output Value\> \<Arithmetic Variable\> = \<Variable\>	
Parameter	Output Variabl	Variable corresponding to DO signal. Single signal is DO, Group signal is GO
	Output Value	Arithmetic Equation. 0～255. (Discards the digits after the decimal point if float type)
	Input Variabl	Variable corresponding to DI signal. Single signal is DI, Group signal is GI
example	DO3 = 1 GO2 = &H7F V20% = DI2 V21% = GI2	

11.2.3.2 PRINT Command

Description	Outputs the specified information to Teach Pendant screen or to serial port.	
Syntax	PRINT \<Output Direction\>, \<Information,… \>	
Parameter	Output Directi on	#0 : Teach Pendant #1 : Serial port COM 1 #2 : Serial port COM 2
	Informa tion	Arithmetic Equation., String equation
example	PRINT #0, "SIGNAL VALUE = " ; V1!	
Comment	If the information is divided by ',', informations are separated by 1 character space' and by ' ;' , it is output without space. If ' ;' is at the end, no open line character is attached.	

11.2.3.3 INPUT Command

Description	Inputs the information to variable from the Teach Pendant screen or serial port.		
Syntax	INPUT <Input Direction>, <variable>[, <timeout time>]		
Parameter	Input Direction	#0 : Teach Pendant #1 : Serial port COM1 #2 : Serial port COM2	
	Variable	Arithmetic Variable, String variable	
	timeout	Arithmetic Equation. If certain time is elapsed, moves to the next line.	sec unit integer 0.0~60.0
example	INPUT #1, V20!, 5 INPUT #0, V1$		

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11.2.4 Program Flow Control

11.2.4.1 GOTO Command

Description	Jumps to the specified address.	
Syntax	GOTO <Address>	
Parameter	Address	Address to be jumped.	
example	GOTO 99 GOTO *ERRHDL	

11.2.4.2 GOSUB ~ RETURN Command

Description	Calls for the address specified by GOSUB. When met with RETURN command, returns to the next line of GOSUB command.	
Syntax	GOSUB <Address> ...... RETURN	
Parameter	Address	Address to call	
| example | ```
      GOSUB 150
      END
  150 REM ---- Subroutine for testing ----
      PRINT #0, "Subroutine Start"
      PRINT #1, "Subroutine End"
      RETURN
``` | |

11.2.4.3 JMPP Command

Description	Jumps to the specified program		
Syntax	JMPP <Program Number>		
Parameter	Program Number	Positive integer, Program number to call	1~999

example	IF DI29=1 THEN
	JMPP 909
	ENDIF
		REM --- subprogram 909 - ERROR STOP
		PRINT #0, "Unrecoverble Error!!!", TIME$
		END	

11.2.4.4 CALL Command

Description	Calls for the specified program. When met with END command, returns to the next line of CALL command called.		
Syntax	CALL <Program Number> ...... END		
Parameter	Program Number	Positive integer, Program number to call	1~999
example	' Distance calculation between P4 and P7. P300=P4 P301=P7 CALL 902 ' Result Output PRINT #0, "Dist = "; V300!	REM --- subprog. 902 ------------------- REM V300! = <Distance between P300 and P301> REM - ---------------------------- V300! = (P300.X-P301.X)^2 + (P300.Y-P301.Y)^2 + (P300.Z-P301.Z)^2 END	

11.2.4.5 ON~GOTO Command

Description	Jumps to the various address depending on the condition number after ON.		
Syntax	ON <Number> GOTO <Address>[, <Address>, <Address>,.....]		
Parameter	Number	Arithmetic Equation. Number determining the jump address. The digit after the decimal point is discarded if Float type. If it's smaller than 1 or bigger than the address number, moves to the next command line.	
	Address	It jumps to if the condition is set to 1, the first address, if 2, second address. Up to 10 addresses can be used.	

example	`    ON V5% GOTO 210, 220, *CONT`
	`    GOTO *ERR`
	`210 PRINT #0, "V5%=1"`
	`    GOTO *CONT`
	`220 PRINT #0, "V5%=2"`
	`    *CONT`		

11.2.4.6 DELAY Command

Description	Delays as much as the specified time.		
Syntax	DELAY <Time>		
Parameter	Time	Arithmetic Equation. Standby time	Unit : sec 0.1~60.0
example	DELAY 0.5		

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11.2.4.7 STOP Command

Description	Stops the program. If restarted, it is continued from the next line.	
Syntax	STOP	

example	IF DI9=1 THEN
	STOP
	ENDIF	

11.2.4.8 END Command

Description	Stops the program. If restarted, it starts over from the beginning.	
Syntax	END	
example	END	

11.2.4.9 WAIT Command

Description	Wait until the condition is met. If the timeout time exceeded, jumps to the shelter address.		
Syntax	WAIT <Condition>[, <timeout Time>, <shelter Address>]		
Parameter	Condition	Arithmetic Equation. Wait until the condition is met.	
	timeout Time	Arithmetic Equation. Limit time of the standby.	Unit : sec 0.0~60.0
	shelter Address	The address to be jumped when the timeout time is exceeded.	
example	WAIT DI20=1, 1.5, *ERR		

11.2.4.10 IF~ELSEIF~ELSE~ENDIF Command

Description	Jumps according to the Condition.		

Syntax	IF <Condition> THEN <Address> [ELSE <Address>]
	IF<Condition> THEN
	~
	[ELSEIF <Condition>
	  ~] (Several Times)
	[ELSE
	  ~]
	ENDIF		

Parameter	Condition file	Arithmetic Equation, String Condition	If 0, false If not 0, true.
	Address	THEN : If condition is satisfied, jump. ELSE : If condition is not satisfied, jump.	

example	IF V2!>SQR(V50!^2+V51!^2) THEN 150 ELSE *AGAIN (Example of simple if instruction)
	IF DI1>=10 THEN (Example of complex if instruction)
	  PRINT #0, "HIGH"
	  PRINT #1, "HR-MSG: HIGH"
	ELSEIF DI1>=0
	  PRINT #0, "LOW"
	ELSE
	  GOTO *ERR
	ENDIF		

11.2.4.11 FOR~NEXT Commands

Description	Repeats the block incrementing the variable value as long as it is smaller or the same as the end value.		
Syntax	FOR <Variable>=<Initial Value> TO <End Value> [STEP <Increment>] ~ NEXT		
Parameter	Variable	Arithmetic Variable. Variable for determining the repetition.	
	Initial Value	Arithmetic Equation. Initially set value for variable	
	End Value	Arithmetic Equation. Repeats only if the variable value is smaller or the same as the end value.	
	Increment	Arithmetic Equation. Increment value for the variable	
example	REM -- Moves toward the shift direction gradually slowing down. FOR V1!=300 TO 0 STEP -33.3 P1=P1+R1 MOVE L, P1, S=V1!mm/sec,A=3,H=1 UNTIL DI1 NEXT		

※ Note : The commands inserted between the commands such as GOSUB～RETURN, IF～ENDIF, FOR～NEXT must be executed in one's inside. In other words, program can not branch off to one's outside by using command such as GOTO or IF command when the block commands is being executed. If not, program can not be executed properly.

But it can branch off one's inside.

(1) Example can make errors.
```
    IF V1%>100 THEN
    GOTO *RANGE        ←  IF command branch off the outside. It can be errors.
    ENDIF
    PRINT V1%
    END
    *RANGE
    PRINT "RANGE ERROR"
    END
```

(2) Example can executed properly
```
    IF V1%>100 THEN *RANGE
    PRINT V1%
    END
    *RANGE
    PRINT "RANGE ERROR"
    END
```

11.2.5 Comments

Description	Used for describing the program operation. No effect on the execution.	
Syntax	REM <Description>	
Parameter	Description	String for description. Up to 254 single byte characters can be used.
example	REM SPOT WELDING #1 'Variables Setting ------------	

11.2.6 ARC Welding

11.2.6.1 ARCON Command

Description	Outputs the welding start command.		
Syntax	ARCON ARCON ASF#=<File Number> ARCON C=<Current Output Value>, {V=<Voltage Output Value> | VP=<Voltage Rate>} [,T=<time>] [,RETRY]		
Parameter	File Number	Arithmetic Equation. The number of the welding start condition file	Rounded 1～32
	Current Output Value	Arithmetic Equation. Welding current output value (0～500)	Unit:A Rounded
	Voltage Output Value	Arithmetic Equation. Welding voltage output value (Individual Power Source) (0～40)	Unit: V [0.0]
	Voltage Rate	Arithmetic Equation. Output value rate about the appropriate welding voltage (Single Power source) (0～100)	Unit: % Rounded
	Time	Arithmetic Equation. Standby time prior to the motion start after ARC On. (0～10)	Unit: sec [0.00]
	RETRY	Retry when the arc generation fails.	
example	ARCON ASF#=1 ARCON C=260, V=30, RETRY		
Comment	The result for each usage is as follows; 1. ARCON : Start welding as set by the condition using ARCCUR, ARCVOL commands. 2. ARCON <File> : Start welding as set by the conditions of condition file. 3. ARCON <Parameter> : Start welding as set by the parameters.		

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11.2.6.2 ARCOF Command

Description	Outputs the Welding End Command.		
Syntax	ARCOF ARCOF AEF#=\<File Number> ARCOF C=\<Current Output Value>, {V=\<Voltage Output Value> | VP=\<Voltage Rate>} [,T=\<Time>] [,ANTSTK]		
Parameter	File Number	Arithmetic Equation. Number of welding end condition file.	Rounded. 1~32
	Current Output Value	Arithmetic Equation. Welding current output value(0~500)	Unit: A Rounded
	Voltage Output Value	Arithmetic Equation. Welding voltage output value (Separate power source) (0~40)	Unit: V [0.0]
	Voltage Rate	Arithmetic Equation. Voltage output rate about the appropriate welding voltage (Single power source) (0~100)	Unit: % Rounded
	Time	Arithmetic Equation. The delay time of the robot body before the ARC Off. (0~10)	Unit: sec [0.00]
	ANTSTK	Automatic Anti-Stick feature	
example	ARCOF AEF#=1 ARCOF C=300, V=V10!, T=1.00, ANTSTK		
Comment	The result for each usage is as follows; 1. ARCOF : Welding ends as previously set by the condition with ARCCUR, ARCVOL commands. 2. ARCOF \<File> : Welding ends as set by the conditions of the condition file. 3. ARCOF \<Parameters> : Welding ends as set by the conditions of the parameters.		

11.2.6.3 ARCCUR Command

Description	Sets the welding current output value with the set value.		
Syntax	ARCCUR C=\<Current Output Value>		
Parameter	Current Output Value	Arithmetic Equation. Welding current output value (0~500)	Unit: A Rounded.
example	ARCCUR C=200		

11.2.6.4 ARCVOL Command

Description	Sets the welding voltage output value with the set value		
Syntax	ARCVOL {V=\<Voltage Output Value> | VP=\<Voltage Rate>}		
Parameter	Voltage Output Value	Arithmetic Equation. Welding voltage output value (0~40)	Unit: V [0.0]
	Voltage Rate	Arithmetic Equation. The voltage rate about the appropriate welding voltage (Single power source) (0~100)	Unit: % Rounded.
example	ARCVOL V=30		

11.2.6.5 ARCDC Command

Description	Sets the welding current command value with the set value.		
Syntax	ARCDC <Current Command Value>		
Parameter	Current Command Value	Arithmetic Equation. Welding current command value	-14.0~+14.0
example	ARCDC 12		

11.2.6.6 ARCDV Command

Description	Sets the welding voltage command value with the set value.		
Syntax	ARCDV <Voltage Command Value>		
Parameter	Voltage Command Value	Arithmetic Equation. Welding voltage command value.	-14.0~+14.0
example	ARCDV 2.5		

11.2.6.7 WEAVON Command

Description	Starts the weaving motion		
Syntax	WEAVON WEV#=<File Number>		
Parameter	File Number	Arithmetic Equation. The number of the weaving condition file	Rounded. 1~32
example	WEAVON WEV#=5		

11.2.6.8 WEAVOF Command

Description	Stops the weaving motion.	
Syntax	WEAVOF	
example	WEAVOF	

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11.2.6.9 REFP Command

Description	Sets the reference point for weaving wall point.	
Syntax	REFP <Ref. Point Number> , [<Aux. Point>]	
Parameter	Ref. Point Number Unsigned integer.	1~8
	Aux. Point Pose type. If hidden pose, it's not set.	
example	REFP 1, P8 REFP 2, (-1073.33, 739.01, 258.30, 0, 76, 23)	

Note

(1) REFP Command belongs to the step as the MOVE command.

(2) When the REFP command is input using the <Aux. Point> key at T/P, it becomes the hidden pose type.

11.3 Others

※ All the factor values can be used in the Arithmetic Equation.

11.3.1 PRINT Command

Description	Robot Interrupt (I signal) (M29)		
Syntax	RINT I=<Isignal>,RF=<STD.>,X=<X coord>,Y=<Y coord>, Z=<Z coord>		
Parameter	I signal	the number of DI signal receiving interrupt	DI range
	STD	Select 0 when using general robot interrupt and select 1 when using search function. Search function referred to M59.	0～1
	X,Y,Z coord.	When using search function	-3000.0 ～3000.0
Example	RINT I=<Isignal>,RF=<STD>,X=<X coord>,Y=<Y coord>, Z=<Z coord>		

Introduction

If the I signal is input during moving to the destination, robot will move the next step. (That is, it is regarded that robot moved to the destination.)

Example

If this condition is satisfied from step 2 recorded this function to step3, robot will execute the functions of step 3 and move to the step 4.

11.3.2 RINTA Command

Description	Robot Interrupt(Analog signal) (M30)		
Syntax	RINTA PT=<Port No>,VL=<Lower volt>,VH=<Upper volt> ,RF=<STD>,X=<X coord>,Y=<Y coord>, Z=<Z coord>		
Parameter	Port No.	Analog port No. receiving interrupt signal	1~4
	Lower volt	if the value of analog is between lower and upper volt, interrupt occurs.	-10.0 ~10.0
	Upper volt		
	STD	0 is off, 1 is On	0~1
	X,Y,Z coord	Used at search function	-3000.0 ~3000.0
Example	RINTA PT=<Port No>,VL=<Lower volt>,VH=<Upper volt> ,RF=<STD>,X=<X coord>,Y=<Y coord>, Z=<Z coord>		

Introduction

If input voltage is satisfied fixed voltage range by using analog sensor, robot will regard as arriving to the next step.

Example

11.3.3 SPOTCND Command

Description	Spot Welding Condition (M33)	
Syntax	SPOTCND <Condition Number>	
Parameter	Condition Number	The condition number output to the welder for welding current change.	0~255
example	SPOTCND 2	

  Introduction

   Spot welding condition signal is used to change the welding current according the thickness of the materials or sheets when spot welding.
Welding condition can be freely changed by connecting this signal to the welder. The welding condition can be to maximum 256 level (0 ~ 255).

It is output in Binary type of 8bit (0 ~ 255).

Or it can be output in Discrete type (0 ~ 7) when selecting <Line No> of welding condition output type (SYSTEM[PF5] → 4.APPLICATION PARAMETER → 1.SPOT&STUD → 1. WELDING PARAMETER)
This signal is to output as welding condition number that is fixed up in "SYSTEM [PF5] → 2. CONTROL PARAMETER → 1. SET UP IN/OUT SIGNAL → 6. ARRAY OUTPUT SIGNAL.

11.3.4 SREQ Command

Description	Shift Requirement (M51)	
Syntax	SREQ R=<Register Number>,PT=<Port Number>	
Parameter	Reg. Number	Register number for saving the received shift amount.	1~8
	Port Number	RS232C port number to be used for shift requirement and transmission.	1~1
example	SREQ R=1,PT=1	

  Introduction

   SREQ is a function to request external equipment to send shift amount. The shift amount is recorded in on line shift register group.

When this function is executed, robot would output data of the format such as SHIFT ※1 CR LF (※1 is register No.) through RS232C port. Then, robot would receive data of the format such as SHIFT X, Y, Z, θX, θY, θZ, CR. The input is recorded in the register ※1. The format of transmit data is ASCII code.

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11.3.5 SONL Command

Description	On-line shift (M52)		
Syntax	SONL ST=<Start/End>,RF=<Std>,R=<Register Number>,SS=<Shelter Step No>		
Parameter	Start/End	If 1, starts the shift application. If 0, ends. If 0, all other factors are ignored.	0~1
	Std.	If 0, based on the ground plane. If 1, based on the tool.	0~1
	Reg. Number	The register number where the received shift amount is stored.	1~8
	Shelter Step No.	Step to jump to when the shift amount is not input within the specified time period.	0~999
example	SONL ST=1,RF=0,R=1,SS=10		

Introduction

   On-line shift is a function to shift parallelly the teaching point to an any place of X, Y, Z coordination by using the shift amount transmitted through the external equipments such as vision system. Generally it is used on the robot base coordination but the robot tool coordination can be selected.

   Examples
  (1) Parallel shift
     When the points A, B, C, D is parallel to the point a, b, c, d as the following picture, the robot plays back the A, B, C, D program that is corrected the difference of 'A' and 'a' by using data from the external equipment with fixed tool angle.

  (2) Tool angle correction shift
     Robot makes a shift with fixed tool angle in the parallel shift. But in the tool angle correction shift, robot makes X, Y, Z shift with corrected tool angle according to the angle of robot coordination from the external equipment.
     As the following picture,
  (3) Jump to shelter
    It is a function to jump to shelter step in case that data is not transmitted to robot during sometime when robot is in on-line shift.
  (4) Request shift amount (M51)
    Shift amount is a need to be transmitted from external equipment. This function (SREQ) is to request shift amount.
  (5) Request shift amount on condition that time (M56)
     This function is same as SREQ. But robot waits during some time (0.1 ~ 60.0sec). And then robot jumps to a shelter if shift amount is not transmitted during that time.

11.3.6 TONL1 Command

Description	Online coordinate conversion (Slipping) (M53)	
Syntax	TONL1 ST=<Start/End>,RF1=<Basic Step number1>,RF2=<Basic Step number2>,RF3=<Basic Step number3>	
Parameter	Start/End	If 1, Coordinate conversion starts. If 0, exits.	0~1
	Basic Step number	The step numbers to be set for 3 base points.	0~999
example	TONL1 ST=1,RF1=1,RF2=5,RF3=7	

  Introduction

  Online coordinate conversion (Slipping) is a function to play back teached position correcting the difference transmitted from the external equipments such as vision system.

   It finds a shift amount of specified basic 3 points and saves the shift amount transmitted through RS232C port in shift registers.

11.3.7 TONL2 Command

Description	Online coordinate conversion (coordinate value) (M54)	
Syntax	TONL2 ST=<Start/End>,RF1=<Basic Step number1>,RF2=<Basic Step number2>,RF3=<Basic Step number3>	
Parameter	Start/End	If 1, coordinate conversion starts. If 0, exits	0~1
	Basic Step number	Step numbers to be set for 3 base points.	0~999
example	TONL2 ST=1,RF1=1,RF2=5,RF3=7	

  Introduction

  Online coordinate conversion (coordinate value) is a function to play back teached position correcting the difference transmitted from the external equipments such as vision system.

   It finds a coordination (robot coordination) of specified basic 3 points and receives coordination through RS232C port and saves shift amount in on line shift registers.

  Note

  (1) TONL1 (M53)：Online coordinate conversion (Slipping) uses the contents of shift registers as shift amount.
  (2) TONL2 (M54)： Online coordinate conversion (coordinate value) uses the contents of shift registers as coordination system.

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11.3.8 SREQT Command

Description	Timer conditional shift function (M56)		
Syntax	SREQT R=<Reg. Number>,PT=<Port Number>,WT=<Standby time>,SS=<shelterStep Number>		
Parameter	Reg. Number	Register number for saving the received shift amount.	1~8
	Port Number	RS232C port number to be used for shift requirement and shift amount transmission.	1~1
	Standby Time	Standby time until receiving the shuft amount.	0.0~60.0 (sec)
	shelter Step No	Step number to be jumped when the standby time is elapsed.	0~999
example	SREQT R=1,PT=1,WT=10.0,SS=100		

Introduction

SREQT is same function as Shift Requirement (M51). But it makes a differences to jump to the shelter step if shift amount is not input during the specified time.

11.3.9 SXYZ Command

Description	XYZ Shift (M58)		
Syntax	SXYZ RF=<Base>,X=<X Shift Amount>,Y=<Y Shift Amount>,Z=<Z Shift Amount>		
Parameter	Base	If 0, ground base. If 1, tool base.	0~1
	Shift Amount	Shift Amount to be shifted parallel in 3D.	-3000.0~ 3000.0
example	SXYZ RF=0,X=10.50,Y=20.50,Z=0.00		

Introduction

XYZ Shift is a function that makes parallel shift with fixed tool angle in XYZ coordination and saves shift amount of 3 dimension.

Note

(1) The Playback of XYZ shift

The distance of X, Y, Z to the end of tool must be set accurately because it makes parallel shift with fixed tool angle.

(2) The Application of XYZ shift

As the following picture, it is used when the points A,B,C,D of workpiece parallelly face each other to the points a, b, c, d.

11.3.10 SEA Command

Description	Search function (M59)		
Syntax	SEA ST=<On/Off>,RF=<Base>,R=<Reg. Number>		
Parameter	On/Off	If 1, On. If 0, Off	0~1
	Base	If 0, ground base. If 1, tool base.	0~1
	Reg. Number	Register number to be used for online shift.	-3000.0~ 3000.0
example	SEA ST=1,RF=0,R=1		

 Introduction

 Search function (M59) can find the differences of the position of workpiece and correct it's differences. It is possible to correct in tool coordination and robot base coordination.

 How to use

1. Specify the search range   (Application condition → Search range)

2. Teach program
  Record requested search function
  (1) Start search
  (2) Robot Interrupt (DI signal)
  (3) End search
  (4) On line shift

3. Turn on the record data of search base   (Application condition → 3. Record search base data)
4. Play back program and record by using interrupt function in   1 cycle mode.
5. Turn off the record data of search base   (Application condition → 3. Record search base data)
6. Play back program

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Application of Search

(1) 1 dimension search

1 Direction Search

Teach Point
Welding Line
Search Range

As the above picture, 1 dimension search can be used in the case of an alike workpiece moving or same type workpiece that have different size.

Search function is used with interrupt function as the above. It correct the difference by using on-line shift after recording the shift amount in shift register. Robot interrupt works at step 3 and saves the shift amount in shift registers. Robot plays back step 4 ~ step 7 correcting position by using shift registers. And robot interrupt function is used with a step of interpolation record

★ a step of interpolation record is a step recorded that interpolation (linear, circular) is on.

(2) 2 dimension search

2 Dimension search

Teach Point
Welding Line
Search Range

----

2 dimension search uses search function twice and records the shift amounts of point
P,Q. The shift amount of point P is recorded in R1 register and referenced during moving
to P point. The shift amount of point Q is recorded in R2 register and referenced during
moving to Q point.

11.3.12 SPOT Command

Description	Servo Gun Welding (M72)		
Syntax	SPOT GN=<Gun No.>,CN=<Welding Condition>,SQ=<Sequence No>		
Parameter	Gun No.	Gun No to weld	1～2
	Welding condition	Welding condition No of data for pressure, welding condition	1～64
	Sequence No	Sequence No that gun actuation and electrifying signal are recorded.	1～64
Example	SPOT GN=1,CN=1,SQ=10		

Introduction

It is a function of spot welding. Gun actuation is controlled by servo system in a different
way of air gun and outlay electrifying signal to a welder after gun acting.

Note

(1) Tool number is changed automatically when gun number is selected(R210) in using of
multi gun. But gun number is not changed automatically when tool number is selected (R49).

(2) Spot function must be recorded at the first function of a step. It will not be executed
when recorded at the second of a step.

(3) Use one touch recording (Gun LED flickering) when step recording. If not, correction
of tip abrasion would not be executed.

(4) Use in small pressure lest a test workpiece is not deformed when teaching. If a test
workpiece is deformed, move the fixed tip.

(5) If the step where spot welding function (M72) is recorded is modified, the amount
of abrasion would be corrected too.

11.3.13 GUNSEA Command

Description	Gun Search (M73)		
syntax	GUNSEA GN=<Gun No>,SE=<Search No>,PR=<Gun Pressure>		
Parameter	Gun No	the gun number to weld	1～2
	Search No	1: Gun search 1 , 2: Gun search 2	1～2
	Gun	Gun actuation pressure	50～999
Example	SPOT GN=1,SE=1,PR=50		

Introduction
It is a function to measure the abrasion amount of tip.

Gun search 1 is to use for measurement the total abrasion amount of tip and Gun search 2 is for measurement the abrasion amount of moving tip. The abrasion amount of fixed tip can be calculated by subtracting the abrasion amount of fixed tip from total abrasion amount.

Note
(1) Record servo gun axis parameter and the base position of gun search before measuring abrasion amount.
(2) Turn on Application → 7. Gun search base position Recording for base position recording of gun search. The measurement data is not abrasion value but basic value to measure.
(3) Gun search 2 must follow gun search 1.
(4) Proceed at the position where gun is open, when recording gun search function,

11.3.14 TIERST Command

Description	Call program to put in a insert sheet (M94)	
Syntax	TIERST R=<Register No>,P=<Pallet No>,PR=<Pattern Register No>,TP=<Insert sheet Program>	
Parameter	Register No On line shift register number	1~8
	Pallet No Pallet number	1~16
	Pattern Register NO Palletizing pattern register number	1~16
	Insert sheet Insert sheet program number	1~999
Example	TIERST R=1,P=4,PR=2,TP=800	

Introduction
It is a function to put in a insert sheet when palletizing. This function is executed when the condition to put in a insert sheet is met.

Note
(1) An sheet insertion program must be fixed up before using this function.
(2) Make sure that the information to put in a insert sheet for a pattern register is correct. Wrong information can cause collision.
(3) This function must be between PAL and PALEND.
(4) This function can be used before palletizing or depalletizing the initial workpiece. The basic position of sheet insertion is the lower of first level when palletizing and the upper of maximum level when depalletizing.

11.3.15 PALPU Command

Description	Palletizing picking up shift (M95)		
Syntax	PALPU P=<Pallet No>,SL=<Start level>,SH=<shift amount>		
Parameter	Pallet No	Pallet number	1～16
	Start level	the level to pick up (1-base)	1～100
	Shift amount	shift amount when picking up	-2000.0～2000.0
Example	PALEND P=1,SL=4,SH=1000		

Introduction

It is a function to shift the position where robot picks up the workpiece after gripping. Robot can take a optimum path according to the change of loading height by using this function.

Note

(1) This function must be between PAL and PALEND.

11.3.16 PAL Command

Description	Palletize (Data Input) (M96)		
Syntax	PAL P=<Pallet No>, PR=<Pattern register No>, W=<Workpiece size>, L=<Workpiece size>, H=<Workpiece size>		
	Pattern Number	Palletize number	1～16
	Pattern Number	Palletize pattern register number	1～16
	Workpiece size(W)	width of workpiece	0.1～3000.0
	Workpiece size(L)	length of workpiece	0.1～3000.0
	Workpiece size(H)	height of workpiece	0.1～3000.0
example	PAL PAL P=1, PR=1, W=500, L=300, H=250.5		

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Introduction

It makes shift amount to palletize by using the data that recorded in palletizing pattern register.

Note
(1) Set up Gun 2 as Palletizing in the menu of "System"[PF2] → 5.Initialize → 4.Set up Using item
(2) Always conform the data of palletizing pattern register ("System"[PF2] → 5.Initialize→ 3.Palletizing → 1.Palletizing Pattern register) before using this function. If using wrong data, robot could not work properly.
(3) This function works only in the step where the condition is PS.
(4) This function(M96) must be one pair with Palletizing End(M97)

11.3.17 PALEND Command

Description	Exits the palletize (Data Input) (M97)	
Syntax	PALEND P=<Pallet number>, ES=<ending signal>	
Parameter	Pallet number	Pallet number to exit	1~16
	Ending signal	the output signal (DO) to be transmitted after ending palletizing. If 0, there is nothing transmitted.	DO range
example	PALEND P=1, ES=81	

Introduction
It is a function to end palletizing. If this function runs, robot would initialize shift amount and transmit specified signal to transfer a pallet.

11.3.18 PALRST Command

Description	Palletize reset (Data Input) (M98)	
Syntax	PALRST P=<Pallet number>, CS=<Condition signal>,RS=<Response signal>	
Parameter	Pallet number	Pallet number	1~16
	Condition signal	Input signal to receive when reset palletizing by force. If 0, reset unconditionally.	DI range
	Response signal	Output signal to respond to forced reset	DO range
example	PALRST P=1, CS=1, RS=5	

Introduction
It is a function to reset palletizing by force. If the specified signal is input, robot would initialize all of informations and transmit a specified output signal to transfer a pallet.

11.3.19 CALLPR Command

Description	Calls other program (Unconditional) (M102)	
Syntax	CALLPR <Program Number>	
Parameter	Program Number	Program number to be called.	1~999
example	CALLPR 2	

Introduction

In case that a robot is handling same workpieces that have a different position   or repeating identical action, there are specific repeated actions.

CALLPR(Call relative program) is used in such case that relative position and direction are same but absolute position is different. You could program the specific programs as one program and call to use it if there is a need.

There is a different point that called program is run in the base of that current position and direction when the program is called compared to just CALL PROGRAM.

You could the result that program No.1 called relatively No.2 as following picture.

Note

When called program is finished, robot executes the next step or function after returning to calling program

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11.3.20 SELCRD Command

Description	Shift coordinate system selection (M113)	
Syntax	SELCRD <Coordinate System Number>	
Parameter	Coordinate System Number	Coordinate System Number to be used among the user coordinate systems.	0~10
example	SELCRD 4	

Introduction

It is a function to select a base coordination to shift. Robot shifts in the base of selected coordination.

Generally shift is executed in the base of robot coordination but robot could execute shift in base of user coordination by using SELCRD command when shift data is transmitted in the form of user coordination.

After this function is executed, all of shift is in the base of selected coordination. So you must select "0" coordination to return to robot coordination.

(1) This function can not change the coordination of "tool coordination shift" in the base of tool coordination.

▶the result of SELCRD in various conditions

base \ Coord. No.	0	1 ~ 10
Ground(robot coord.)	Robot coord. shift	User coord. shift
Tool(Tool coord.)	Tool coord. shift	Tool coord. shift

(2) Shift coordination would be changed at the next step that this function is recorded.

(3) SELCRD function can be applied to the following functions
  · SONL (M52) on-line shift
  · TONL1 (M53) & TONL2 (M54) on-line coordination transformation
  · SXYS (M58) XYZ shift
  · SEA (M59) search
  · PAL (M96) palletizing (data input)
 (4) There are referent functions such as "SYSTEM[PF2] → 2. CONTROL PARAMETER → 12. RECORD COORDINATION → 1. RECORD USER COORDINATION" and "SET UP CONDITION[PF5] → 8. SELECT USER COORDINATION"

11.3.21 MIT Code

Description	All kinds of M.I.T. function codes can be used as required.	
Syntax	M\<Code Number\> \<Factor 1\>,\<Factor 2\> I\<Code Number\> \<Factor 1\>,\<Factor 2\> T \<Delay Time\>	
Parameter	Code Number	Positive Integer, M : 0~113, I : 1~55	
	Factor	Arithmetic Equation, Factors to be handed to M, I, T function.	
example	M0 M81 5,1 M99 ARC WELDING 1 M101 1,"JOB FINISHED" M105 8,V1% I52 1,2.0,1 I53 1,&B10001,2.0,1 T 0.5	

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11.4 Function

11.4.1 Arithmetic Function

The functions that have the numeric value returned, are called the arithmetic functions.

Function Name	Description	Example
ABS(a)	Returns the absolute value of a	V19!+ABS(V20!)
MAX(a, b)	Returns the bigger value between a and b.	MAX(V20!, 0)
MIN(a, b)	Returns the smaller value between a and b.	MIN(V20!, 10)
DEGRAD(a)	Returns radian value of a in degree.	DEGRAD(270)
RADDEG(a)	Returns degree value of a in radian.	RADDEG(3.1415*V20!)
SQR(a)	Returns a square root of a.	SQR(V20!)
SIN(a)	Returns a sine value of a in radian.	SIN(V20!)
COS(a)	Returns a cosine value of a in radian.	COS(V20!)
TAN(a)	Returns a tangent value of a in radian.	TAN(V20!)
ATN(a)	Returns a arctangent value of a in radian.	ATN(V20!)
ATN2(a, b)	Returns a arctangent value of a triangle which have x length of a and y length of b, in radian.	ATN(V25!, V26!)
DIST(a, b)	Returns the distance to a point which x coordinate is a and y coordinate is b.	DIST(V5!, V6!)
ORD(a)	Returns the character code for the first character of the string.	ORD("ERROR")
VAL(a)	Returns the value of a number described in string.	VAL("29.38E-2")
STRPOS(a, b)	Returns the first location matching to b string within a string.	STRPOS(V7$, "=")
LEN(a)	Returns the length of a string.	LEN(V8$)
TIMER	Gets the elapsed time from the power on in seconds.	TIMER

11.4.2 String Function

The functions that have the string returned, are called the string functions.

Function Name	Description	Example
CHR$(a)	Returns a character which has the character code of a.	CHR$(7)
STR$(a)	Returns a decimal string corresponding to number a.	STR$(13.25)
BIN$(a)	Returns a binary string corresponding to a number a.	BIN$(&B0010)
HEX$(a)	Returns a hexa string corresponding to a number a.	HEX$(&H7A2F)
MIRROR$(a)	Returns the reverse string corresponding to a binary string a.	MIRROR$("HELLO")
LEFT$(a, b)	Returns a string of b characters of string a.	LEFT$("HELLO", 2)
MID$(a, b, c)	Returns a string of c characters from bth characters of string a.	MID$("HELLO", 1, 3)
RIGHT$(a, b)	Returns a string of b characters from the back of string a.	RIGHT$("HELLO", 2)
DATE$	Returns a current date string (YY/MM/DD)	DATE$
TIME$	Returns a current time string (HH:MM:SS)	TIME$

11.4.3 Robot Language corresponding to a existing MIT Function Code.
The same result of each operation of existing MIT function code can be obtained by using the robot language command instructions in appropriate places. The followings are the examples of such cases. The code corresponding to the other command instruction are indicated by the background color.

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M I T Function Code		Example of corresponding HR - BASIC syntax.
M0	DO signal RESET	GO1=0
M1~8	DO signal ON/OFF	DO1=1~DO8=1 or DO1=0~DO8=0
M10	DO signal RESET	GO2=0
M11~18	DO signal ON/OFF	DO11=1~DO18=1 or DO11=0~DO18=0
M20	Step Jump (Uncond.)	GOTO <Address>
M21	Step Call (Uncond.)	GOSUB <Address>
M22	Step Return (Uncond.)	RETURN
M23	Step Jump (Conditional)	IF DIn=1 THEN <Address>

M24	Step Call (Conditional)	IF DIn=1 THEN
		    GOSUB <Address>
		ENDIF

M25	Step Return (Conditional)	IF DIn=1 THEN
		    RETURN
		ENDIF

M26	Step Jump (Count Conditional)	IF Vn%=<Count> THEN <Address> Vn%=Vn%+1 (Vn% value is initialized out of cycle).

M27	Step Call (Count Conditional)	IF Vn%=<Count> THEN
		    GOSUB <Address>
		ENDIF
		Vn%=Vn%+1 (Vn% value is initialized out of cycle).

M28	Step Return (Count Conditional)	IF Vn%=<Count> THEN
		    RETURN
		ENDIF
		Vn%=Vn%+1 (Vn% value is initialized out of cycle).

M29	Robot Interrupt (DI signal)	MOVE L, P1, S=..., A=..., H=... UNTIL <I Signal>=1
M32	Output signal SET	DOn=1
M33	Spot welding condition	SPOTCND
M34	Output signal RESET	DOn=0
M41	Robot Stop (Uncond.)	STOP

M42	Robot Stop (Conditional)	IF DIn=1 THEN
		    STOP
		ENDIF

M43	Line number designated output within MB signal group	GO<Group Number>=<8bit Binary>
M44	binary coded output within MB signal group.	GO<Group Number>=<Data>

M I T Function Code		Example of corresponding HR - BASIC syntax.
M51	Shift Requirements	SREQ
M52	Online Shift	SONL
M53	Online Coordinate Conversion	TONL1
M54	Online Coordinate Conversion	TONL2
M56	Timer Cnditional Shift Function.	SREQT(SREQT)
M58	XYZ Shift	SXYZ
M59	Search Function	SEA
M62	Function setting Step Jump (Uncond.)	GOTO <Address>
M63	Function setting Step Jump (I conditional)	IF DIn=1 THEN <Address>
M64	Function setting Step Jump (Count Conditional)	IF Vn%=<Count> THEN <Address> Vn%=Vn%+1 (Vn% value is initialized out of cycle).
M68	Shift Amount Substitution	Rn=<Pose Constant> n= 1~8
M69	Shift Amount Addition	Rn.X=Rn.X+<Addition value>.... n is 1~8 for each element.
M70	Count Register Initial Value Setting	LETN
M80	Program Call (Uncond.)	CALL <Program Number> (At the end of called program END)

M81	Program Call (DI Cond.)	IF DIn=1 THEN
		    CALL <Program Number> (At the end of called program
		                                 END)
		 ENDIF

M82	Prograsm Call (Count Conditional)	IF Vn%=<Count> THEN
		    CALL <Program Number> (At the end of called
		                                 program, END)
		 ENDIF
		 Vn%=Vn%+1 (Vn% value is initialized out of cycle).

M83	Program Jump (Uncond.)	JMPP <Program Number>

M84	Program Jump (DI Cond.)	IF DIn=1 THEN
		    JMPP <Program Number>
		 ENDIF

M85	Program Jump (Count Conditional)	IF Vn%=0 THEN
		    JMPP <Program Number>
		 ENDIF
		 Vn%=Vn%+1 (Vn% value is initialized out of cycle).

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M I T Function Code		Example of corresponding HR - BASIC syntax.
M86	Function Jump (Count Conditional)	Vp%=Vn%/<Division Count> or Vp%=Vn% MOD <Division Count> value is initialized out of cycle). ON Vp%+1 GOTO <Address1><Address2><Address3>...
M87	Function Jump (I Conditional)	Vn% = DIn2*2^2 + DIn1*2 + DIn0 ON Vn%+1 GOTO <Address1><Address2><Address3>...
M88	Function Jump Exit	Not required
M92	END	END
M94	Call Insert sheet program	TIERST R=1,P=4,PR=2,TP=800
M95	Palletizing picking up shift	PALPU P=1,SL=4,SH=1000
M96	Palletizing shift	PAL P=1,PR=1,W=500,L=300,H=250.5
M97	Palletizing end	PALEND P=1,ES=81
M98	Palletizing reset	PALRST P=1,CS=1,RS=5
M99	Comment Function	'SPOT WELD or REM SPOT WELD
M101	String Output (RS-232C)	PRINT #1," <String>"
M102	Other Program Call (Uncond.)	CALLPR
M103	Other Program Call (I Cond.)	Use IF instruction
M104	Other Program Call (Count Cond.)	Use IF instruction, and variable value increment
M105	Output Signal(ON/OFF)	DOn=1 or DOn=0
M113	Shift Coordinate System Selection	SELCRD
I1~24	Signal Wait	WAIT DIn=1
I25	I Signal Wait (Input Signal Setting)	WAIT DIn=1
I26	I Signal Wait (Sub-Logic Signal)	WAIT DIn=0
I52	Time Conditional I Signal Wait	WAIT DIn=1,<Wait Time>,<shelterAddress>
I53	Time Conditional IB Signal (AND)	WAIT (GIn AND <Binary Condition>)=<Binary Condition>, <Wait Time> , <shelterAddress>
I54	Time Conditional IB Signal (OR)	WAIT GIn AND <Binary Condition>, <Wait Time>, <shelterAddress>
I55	Time Conditional IB Signal	WAIT GIn=<Binary Condition>, <Wait Time>, <shelterAddress>
T	Delay Time Setting	DELAY <Delay Time>

Chapter 12 Signal Connection

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CHAPTER 12 SIGNAL CONNECTION

12.1 EXTERNAL INPUT SIGNAL (BD430/BD431)

12.1.1 INPUT CIRCUIT

- Connector Specification
  Board-side : 3M MDR 10240-52A2JL

Plug-side : 3M MDR 10140-3000VE (HOOD;10340-55F0-008)

- Connection Specification

  Input port device : AC input type photocoupler
  Input impedance = 3 kΩ
  Common (+) input voltage = 24VDC
  Common (-) input voltage = 0VDC

- Connection Diagram

Common (+) or (-) voltage

Note.

(1) Use external power source.

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12.1.2 CNIN2 Input Signal

Pin No.	Symbol	Description (for expanded board / for base board)
1	DI01	general-purpose input 1
2	DI02	general-purpose input 2
3	DI03	general-purpose input 3
4	DI04	general-purpose input 4
5	DI05	general-purpose input 5
6	DI06	general-purpose input 6
7	DI07	general-purpose input 7
8	DI08	general-purpose input 8
9	COMIN5	common voltage input (user's power): +24 V or 0V for DI01~DI08
10	COMIN5	
11	DI09	general-purpose input 9
12	DI10	general-purpose input 10
13	DI11	general-purpose input 11
14	DI12	general-purpose input 12
15	DI13	general-purpose input 13
16	DI14	general-purpose input 14
17	DI15	general-purpose input 15
18	DI16	general-purpose input 16
19	COMIN6	common voltage input (user's power) : +24 V or 0V for DI09~DI16
20	COMIN6	
21	DI17	general-purpose input 17
22	DI18	general-purpose input 18
23	DI19	general-purpose input 19
24	DI20	general-purpose input 20
25	DI21	general-purpose input 21
26	DI22/WI	general-purpose input 22(welding complete signal input)
27	DI23/EX_START	general-purpose input 23(external start signal input)
28	DI24/EX_STOP	general-purpose input 24(external stop signal input)
29	COMIN7	common voltage input (user's power) : +24 V or 0V for DI17~DI24
30	COMIN7	
31	DI25/PI1	general-purpose input 25(external program select signal 1)
32	DI26/PI2	general-purpose input 26(external program select signal 2)
33	DI27/PI3	general-purpose input 27(external program select signal 3)
34	DI28/PI4	general-purpose input 28(external program select signal 4)
35	DI29/PI5	general-purpose input 29(external program select signal 5)
36	DI30/PI6	general-purpose input 30(external program select signal 6)
37	DI31/PI7	general-purpose input 31(external program select signal 7)
38	DI32/PI8	general-purpose input 32(external program select signal 8)
39	COMIN8	common voltage input (user's power) : +24 V or 0V for DI25~DI32
40	COMIN8	

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1) General DI Signal

DI1 ~ DI18 signal connect as followings.

2) External start, External stop

 It connects external Start/Stop signal, External Motors OFF for controlling the
operation in external unit.

    But, set up External stop as 0 of "PF2(system), 2 : Control parameter, 1:Set up of
    In/Out signal, 6:Array of input signal" in case that you don't use external stop.

3) Connection of Program selection Signal, Discrete/Binary Signal

 It is selects the external program selection by this signal at playback. It is selected
to [Enable] "System[PF5] → 1. User Define → 8. External Program Select. There are
Discrete/Binary input in program selection signal. You can select one of 8 signal for Discrete
input, and one of 225 signals for binary input.

Connect program selection signal as followings.

Connect Discrete/Binary input signal as followings.

※ It is a binary input in case that this signal is open.

4) Program Strobe Signal

 It decides to confirm program selection signal.

 It acquire the signal in a stable timing between the input signals to decide the timing being read for the program selection for external.

(1) Binary program selection in case that program strobe signal is not used.

※ Turn it on always.

12.2 External Output Signal (BD430, BD431)

12.2.1 Output Circuit

All output circuit are as followings.

- Connector Specification
  Board-side : 3M MDR 10250-52A2JL

Plug-side : 3M MDR 10150-3000VE (HOOD;10350-52F0-008)

- Connection Specification

* BD430
  Output port device : PNP transistor open collector
  Output rating = 125mA(Continuous load current), 24VDC
  Common (-) input voltage = 0VDC

* BD431
  Output port device : MOS relay
  Output rating = 125mA(Continuous load current), 24VDC
  Common (+) input voltage = 24VDC
  Common (-) input voltage = 0VDC

- Connection Diagram

BD431 Board : Common (+) or (-) voltage

BD430 Board : Common (-) voltage only

Note

(1) Use external power source for power source.

(2) All output signals are from transistor open collector output. So, use them within the rating. (Otherwise a circuit may be damaged.)

(3) Set noise absorbing diode to a load.

12.2.3 CNOUT2 Output signal

Pin	Singal	Discription
1	DO01	General output signal 1
2	DO02	General output signal 2
3	DO03	General output signal 3
4	DO04	General output signal 4
5	DO05	General output signal 5
6	DO06	General output signal 6
7	DO07	General output signal 7
8	DO08	General output signal 8
9	COMOUT5	common voltage input (user's power): +24 V or 0V for DO01~DO08
10	COMOUT5	
11	DO09	General output signal 9
	DO10	General output signal 10
13	DO11	General output signal 11
14	DO12	General output signal 12
15	DO13	General output signal 13
16	DO14	General output signal 14
	DO15	General output signal 15
18	DO16	General output signal 신호 16
19	COMOUT6	common voltage input (user's power): +24 V or 0V for DO09~DO16
20	COMOUT6	
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31	DO17	General output signal 17
32	DO18	General output signal 18
33	DO19	General output signal 19
34	DO20	General output signal 20
35	DO21	General output signal 21
36	DO22	General output signal 22
37	DO23/GUN1	General output signal 23 / GUN Signal 1
38	DO24/GUN2	General output signal 24 / GUN Signal 2
39	COMOUT7	common voltage input (user's power): +24 V or 0V for DO17~DO24
40	COMOUT7	
41	DO25/MX	General output signal 25 / MX Signal
	DO26/PROGRAM END	General output signal 26 / Program end signal
43	DO27/TOTAL ERROR	General output signal 27 / System fault
44	DO28/INTERLOCK ERROR	General output signal 28 / Input Signal Wait Time Over
45	DO29/RUNNING	General output signal 29 / Robot running
46	DO30/AUTO MODE	General output signal 30 / Auto Mode
	DO31/ROBOT READY OK	General output signal 31 / When Robot is ready to Start
48	DO32/HOME	General output signal 32 / When Robot is on the Home Position
49	COMOUT8	common voltage input (user's power): +24 V or 0V for DO25~DO32
50	COMOUT8	

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1) General DO Signal

Connect DO 1~ DO 8, DO 11 ~ DO 18 output signal as followings.

----

2) GUN Signal

It is output this signal after arriving to the recorded point (destination point) if it is GUN output function on a destination step at playback.

3) MX Signal

It is output (ON/OFF) according to the condition of destination step before starting from destination step.

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4) PROGRAM END

It is output when program is ended in playback.

Refer to "SYSTEM [PF5] → 2. CONTROL PARAMETER → 6. END Relay Output

Time for the setting of end signal output time.

5) TOTAL ERROR SIGNAL

It is output in case of occurring a serious system error. It resets the
output status by the motors ON after curing error or RESET SET key.

6) EMERGENCY STOP

It is output when emergency stop is pressed.

7) STEP SET ALARM SIGNAL

It is output this signal when a step which is kept away from the current step by two or more steps, is specified in the one step or teach mode. It is output for 200msec.

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8) INTERLOCK ERROR SIGNAL

It is output this signal in case that interlock signal is not input despite of exceeding the time set in "SYSTEM [PF5] → 2. CONTROL PARAMETER →

7. Interlock Error Time   waiting interlock in playback.

If interlock signal is normally input after this signal is output, the next step is executed at that state.

9) PROGRAM ACK. SIGNAL

It is output the confirming signal when program is selected by external program selection. This signal is output for 200msec

10） ROBOT RUNNING

It is out the confirming signal that robot is running.

11） IN LOW MODE SIGNAL

It is output when low speed command is input or low speed mode is set.

12) ROBOT READY SIGNAL

It is output when automatic operation is enable.

Refer to "SYSTEM [PF5] → 2.CONTROL PARAMETER → 3.Robot Ready for the condition
   of robot ready.

13) ROBOT HOME SIGNAL

It is output when the robot locates on the position set on "SYSTEM [PF5] →

2. CONTROL PARAMETER 4. Home Position Registration.

12.3 BD481 CIRCUIT DRAWING

BD481 *CN_WIF* Connector

1 : outTORCHSW
2 : outINCHING
3 : outRETRACT
4 : outSTICKCHK
5 : outGASVALVE
6 : outRESERVED
7 : N.C.
8 : outCOM
9 : outCOM
10 : outCOM

11 : inWCR
12 : inSHOCKSENSOR
13 : inWIRESTICK
14 : inWELDERERROR
15 : inWIRESTATE
16 : inGASSTATE
17 : N.C.
18 : AGND
19 : AGND
20 : AGND

EXTERNAL
WELDING
SYSTEM

3M 10220-52A2JL

3M 10120-3000VE

Specification of Connector

ITEM	MAKER	TYPE	SPECIFICATION
Receptacle	3M	10220-52A2JL	MDR system, 20-Pin
Header	3M	10120-3000VE	MDR system, 20-Pin
Hood	3M	10320-52F0-008	MDR system, 20-Pin

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BD481 *TBAIO* Terminal Block

ITEM	MAKER	TYPE	SPECIFICATION
TERMINAL BLOCK (Plug Part)	PHOENIX	MCV1.5/10-ST-3.81	10-pin, 3.81mm pitch, Plug Part
TERMINAL BLOCK (Housing)	PHOENIX	MCV1.5/10-G-3.81	10-pin, 3.81mm pitch, Housing

BD481 *CNSTK* Connector

ITEM	MAKER	TYPE	SPECIFICATION
TERMINA L BLOCK	P H	MKDS 1/2-3.81	2-pin, 3.81mm pitch, Terminal Block

BD481 *CNPOW* Connector

ITEM	MAKER	TYPE	SPECIFICATION
CONNECTOR(Header)	AMP	770966-1	MATE-N-LOCK Header, 2-Pin
CONNECTOR(Plug)	AMP	172165-1	MATE-N-LOCK Plug, 2-Pin
CONNECTOR(Contact)	AMP	770988-1	MATE-N-LOCK Contact, AWG22

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